

# HANDS ON- IDEAS AND ACTIVITIES

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## SCIENCE SENSE

Children learn a great deal without being taught. To be able to “speak” is a great life skill. Children learn to “speak” not in the school, but at home. One educationist candidly remarked, “It is nice that children spend just a few hours at school. If they spend all 24 hours in school, they will all turn out dumb!” In most schools - teacher’s talk, children listen. The same is true for other skills too. Children learn a great deal by tinkering and pottering on their own. In their free moments they are always doing and making things.

Learning by experience is profound knowledge. It is more deeply imprinted in memory than words or formulas. Children need enriching experiences with different materials and in diverse situations.

Burettes, pipettes, test tubes – and other fancy laboratory apparatus often threaten children. Science principles are best understood if children can see them in a toy – something they can play with. For children the whole world is a laboratory and life itself is a series of experiments. They have an innate ability to see patterns in “little” things around them. All children love making “action” toys that spin, fly, whistle, jump, and hop.

This book is a collation of some interesting activities - geometry by paper folding, toys, tangrams, pumps, caps, experiments, and simple science models. These activities are interspersed with inspiring stories on education, peace, environment and mathematics. More than one thousand line drawings illustrate the text. This book follows no strict order or hierarchy. It is not meant for any specific age group, nor does it supplement or complement textbooks. This book shows possibilities of doing science with simple things. The ability to improvise experiments with almost zero-cost, holds great promise in this resource-starved country. The message is loud and clear -school kids can do great science with little money and resources. Newspapers make great caps. Origami – paper folding is a wonderful way to learn practical geometry. Film-roll cans, mineral water bottles, rubber slippers, crown caps make lovely action toys. Making patterns out of seeds, stones, leaves, and thumbprints, apart from being fun are deeply creative and satisfying activities.

We buy more than we need and generate enormous amounts of “junk” burdening the earth. To heal the earth we need to reduce, recycle and reuse. Sustainability demands that we do more with less. Often creativity blossoms in conditions of scarcity – when there is a paucity of resources.

In collating this book I have relied heavily on old books – most of them out of print. Some of them are my own inventions but the majority of them are drawn from other sources, which have been acknowledged in the reference at the end. Several of these books like the *VSO Science Teacher’s Handbook*, UNESCO’s *700 Science Experiments for Everyone* and *Helping Health Worker’s Learn* by David Werner have always been in the public domain and have enriched many. Some of the modern books on science experiments, despite their gloss and colour are less interesting, because they all copy experiments from their predecessors!

This collation has stories interspersed with activities. Some of these stories have deeply inspired me, stirred me. I have retold them to share their joys with others. I hope stories like *The Man Who Planted Trees*, *The Generous Tree*, *School of Barbiana*, *The Man Who Loved Numbers*, *Danger School!* *The Bull Who Loved the Smell of Flowers* and Dalai Lama’s words of wisdom will have their magical effect on you. We are a billion people. Still, many old science classics are not available to teacher’s in our country. **Vigyan Prasara** has endeavoured to reprint low-cost editions of these. They have been listed at the end of the book. For the last several years we have struggled hard to translate and make available some of the world’s most inspiring books on education *Divasvapna*, *Tottochan*, *Summerhill*, *Teacher*, *Duishen*, *How Children Fail*, *Letter to a Teacher*, *Bahuroope Gandhi* etc. into Indian languages. Hope someday all the good books in the world will be digitised and will be available to every child - rich or poor, at the click of the mouse. Only then will the dream of “**A Million Books for a Billion People**” come true.

The great pioneers of science did their work with simple equipment. It is possible to follow their footsteps and do scientific thinking without much expensive and elaborate apparatus. After all, the student’s mind is the most precious piece of equipment involved!



## THE HEIGHT OF IT!

Clever students seldom do things the intended way!

The graduate class was asked the following question as part of the final exam paper in Copenhagen University: "How will you find the height of a skyscraper using a barometer?"

One student answered: "I will hang the barometer with a long rope from the top of the building. Once the barometer touches the ground then I will measure the length of the rope. I will add the height of the barometer to the length of the rope to determine the height of the skyscraper."

The examiner felt almost offended after reading this very original solution. He got very angry and failed the student. The aggrieved student appealed to the University and pleaded that his answer was correct and if any proof was required it could be tested. The University was in a fix. It appointed an external, neutral examiner to objectively and dispassionately unravel the truth. After a deep probe the external examiner gave his verdict: "Though the student's answer is correct it does not reflect any deep understand of physics." So it was decided to call the student for a six-minute interview to test his understanding and grasp of the basic principles of physics.

During the interview, the student sat absolutely silent with his head hung low for the first five minutes. When the examiner reminded him of the time limit the student replied, "Sir, I know of several elegant solutions. But I am unable to decide on the most appropriate one!"

On being coaxed by the examiner the boy gave a quick reply:

"Well, you can drop the barometer from the top of the skyscraper.

Measure the period 't' of fall. Then using the equation  $H = 0.5 g \times t \times t$  calculate the height of the building. In this experiment the barometer, of course, will get smashed to pieces.

Or else, if it is a sunny day, then you can first measure the actual height of the barometer and the length of its shadow. Next you measure the length of the shadow cast by the skyscraper. Later, using simple arithmetic and the principle of similar triangles you can find the height of the skyscraper.

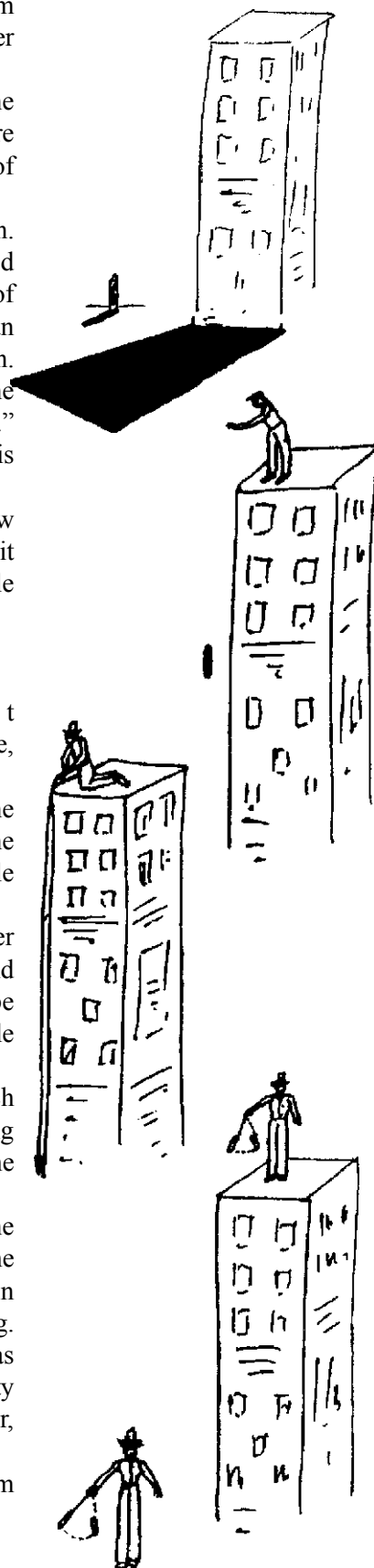
But if you wish to use a very precise scientific method then tie the barometer to the end of a short string and swing it like a pendulum - first on ground and then on roof of the building. The height of the skyscraper can then be determined by using the simple equation for finding the time period of a simple pendulum.

But if the skyscraper has an emergency staircase then the task will be much easier. While climbing up the stairs keep measuring the height of the building using the barometer like a scale. Later you can add them up to calculate the height of the skyscraper.

But if you wish to adopt a very conventional and boring way then using the barometer you can measure the difference in the atmospheric pressure on the ground and the top of the building. This difference in air pressure given in "milli-bars" can later be converted into feet to give the height of the building. But students are always asked to use their own original and independent ideas to learn science, so the best solution would undoubtedly be to go to the security guard of the building and tell him, 'Here, you can have this brand new barometer, but first you will have to tell me the height of the building!'"

The name of this student was Neils Bohr - the first and only person from Denmark to win a Noble Prize in Physics.

(Pix: Abha Mehrotra)



## THE PARADOX OF OUR TIMES

Is that we have taller buildings, but shorter tempers  
Wider freeways, but narrower viewpoints  
We spend more, but we have less  
We have bigger houses, but smaller families  
More conveniences, but less time  
We have more degrees, but less sense  
More knowledge, but less judgement  
More experts, but more problems  
More medicines, but less wellness  
We have multiplied our possessions, but reduced our values  
We talk too much, love too seldom, and hate too often  
We have learnt how to make a living, but not a life  
We have added years to life, but not life to years  
We've been all the way to the moon and back  
But have trouble crossing the street to meet the new neighbour  
We have conquered outer space, but not inner space  
We've cleaned up the air, but polluted our soul  
We've split the atom, but not our prejudice  
We've higher incomes, but lower morals  
We've become long on quantity but short on quality  
These are the times of tall men, and short character  
Steep profits, and shallow relationships  
These are the times of world peace, but domestic warfare  
More leisure, but less fun; more kinds of food, but less nutrition  
These are the days of two incomes, but more divorces  
Of fancier houses, but broken homes  
It is a time when there is much in the show window  
And nothing in the stockroom  
A time when technology can bring this letter to you  
And a time when you can choose  
Either to make a difference.... or just hit, delete.

**- His Holiness the Dalai Lama**



## THUMBPRINTS

Thumbprints can be amazing fun. Try some!

Of all the little  
things we seek  
Our thumb appears,  
to be unique.

Have you seen  
your own thumbprint?  
It has a  
unique imprint.

No two thumbprints,  
look the same.  
But they make  
a very good game.

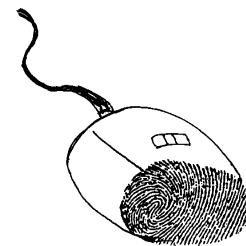
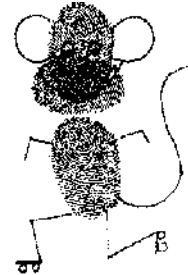
Six billion people,  
throng the globe.  
Each with a  
unique thumb lobe.

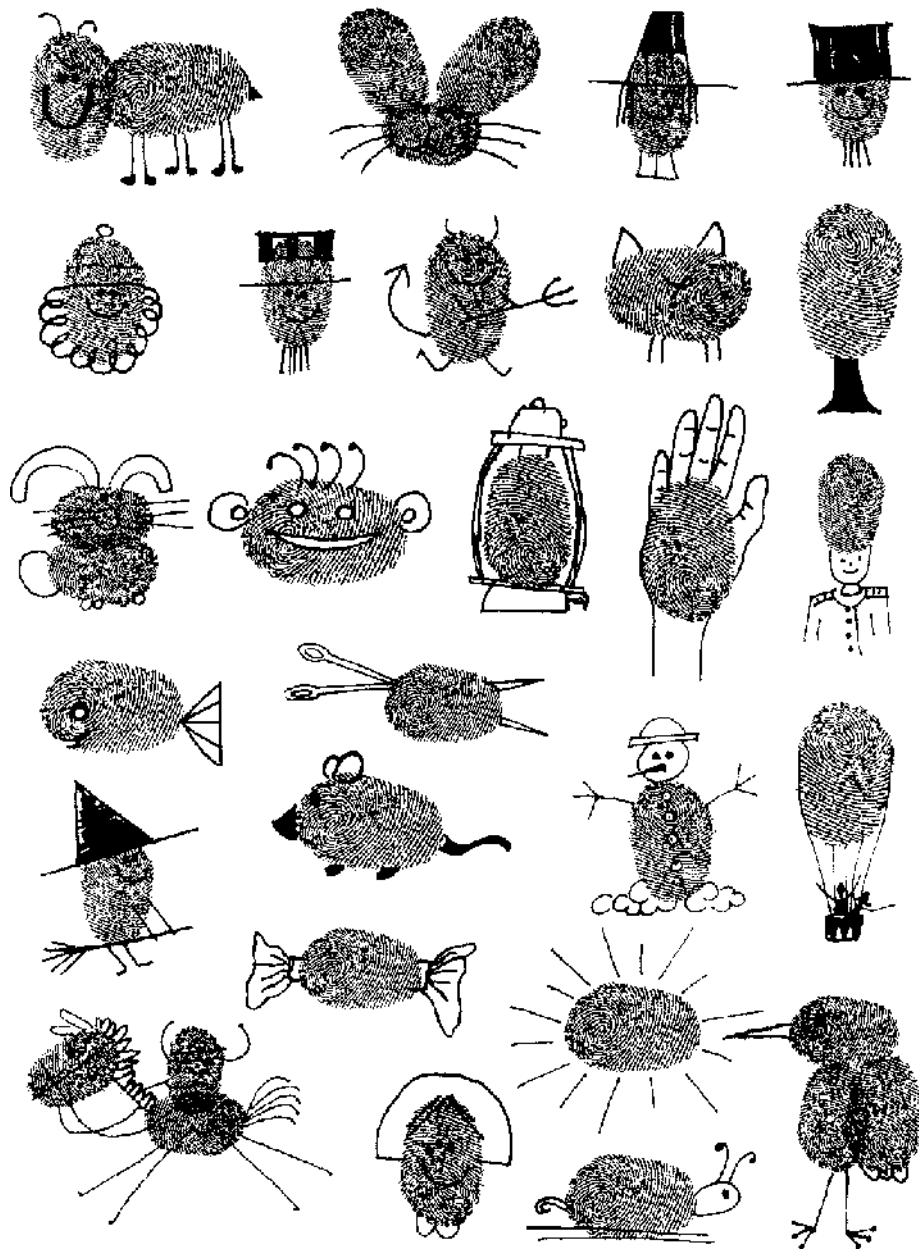
Every thumbprint,  
in the world,  
Has different lines,  
different whorls.

Print your thumb,  
look up or down.  
You might find,  
in it a clown.

A bird, a lion,  
a crawling snail.  
A fish, a peacock,  
snorting whale.

In your thumbprint,  
you will find.  
Lots of things,  
to open the mind.





## THE GENEROUS TREE

The most inspiring “green” tale ever. Adaptation of Shel Silverstein’s classic *The Giving Tree*.

Once there was a tree and a little boy. The tree loved the boy very much. Everyday the boy played under the tree. He picked up flowers and made them into a garland. He climbed the tree trunk and swung from its branches. He played hide and seek with the squirrels and talked to the birds. By afternoon he got very tired. Then he slept under the shade of the tree. Whenever he felt hungry he ate the fruits of the tree. The boy loved the tree too. But time flew by. And the boy grew up. Then he stopped coming to the tree. The tree felt very sad and lonely.

After many years one day the boy came to the tree. The tree was overjoyed to see him. He said, “Come boy, come play and have fun. Climb on my trunk and swing from my branches.” The boy said, “I don’t have time for that anymore. I want some money. I want to go to the bazaar and buy something. Can you give me some money?” The tree replied, “I don’t have any money to give you. But you can pluck my fruits and sell them in the market. Then you will have the money to buy what you want.” So the boy took all the fruits. The tree was happy. The boy disappeared. Years passed.

One day the boy came and said, “I need a house. Soon I will be married and I will need a house for my wife and children.”

“You can chop my branches and make a log house”, said the tree. And this is what the boy did. The tree was still happy. Now all that remained of the tree was its tall trunk.

Several years passed and the boy did not come back. The tree remembered him and felt sad. So, one day when the boy came the tree actually shook its leaves with joy. The boy was carrying a kind of executive briefcase.

“What can I do for you my child?” asked the tree.

“Well, I have to go on a business trip for which I need to cross the sea. I urgently need a boat. Can you give me one?”

The tree thought for a while and said, “All I have left is a trunk. You can make a boat out of it.” So the tree lost its trunk too.

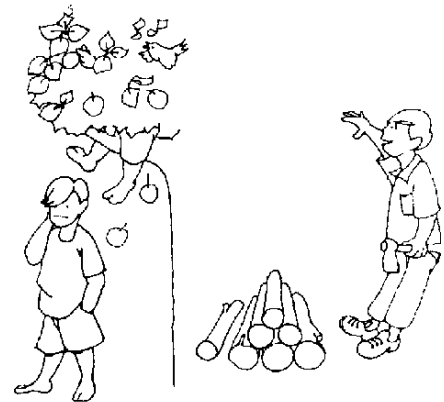
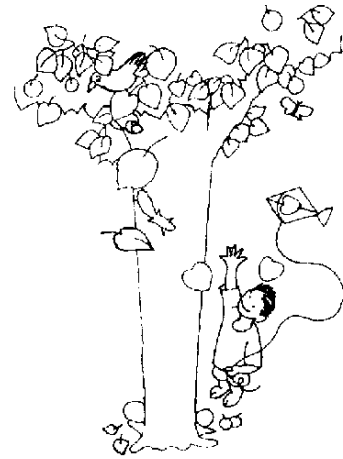
All that was left of the tree was a stump.

Many-many years passed. One-day one doddering old man came up to the stump. The tree immediately recognised him to be its childhood friend. The tree was very apologetic. It said,

“Sorry, my friend I have nothing left to give you. My fruits are gone. My branches and trunk are gone. All that is left of me is a lowly stump.”

The old man sighed and said, “You see, I have no teeth left to eat your fruit. Nor do I have energy left to climb up your trunk and swing from your branches. I am too old and tired. All I want is a place to rest and relax.”

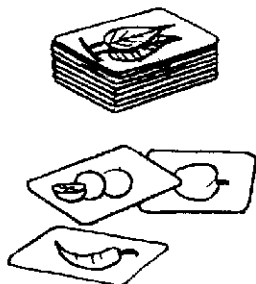
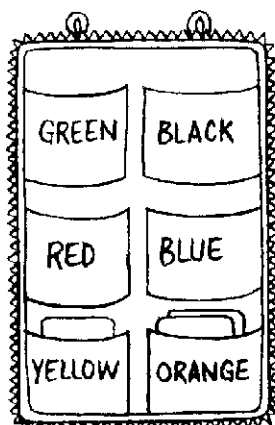
“Then sit on me,” said the tree. The tree was still happy.



(Pix: Dilip Chinchalkar)

## COLOUR MATCHING

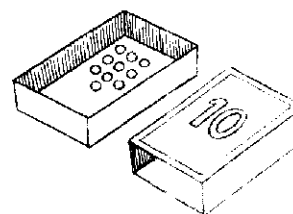
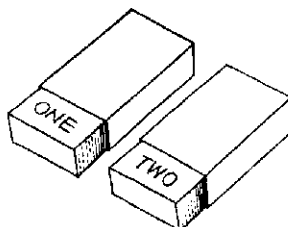
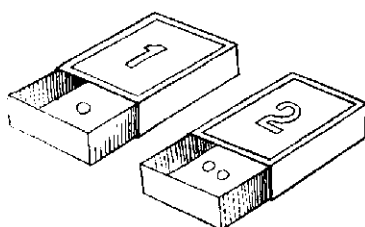
This is a simple and popular activity for little children.



Make a cloth bag with several small pockets. Stitch the pockets with colour cloth. For instance, the 'GREEN' pocket should be made from green coloured cloth. Draw common things on a pack of plain cards with black sketch pen. These things could include leaves, vegetables, fruits and other common objects. Children take turns in playing the game. They remove one card from the pack, and place it in the right colour pocket. For instance a "brick" might go into the red pocket. There might be instances when it might be possible to put the card in more than one pocket. For instance, chillies could be green or red. This could lead to an animated discussion.

## NUMBER MATCHING

This activity gives children an opportunity to match numerals to actual number of things.

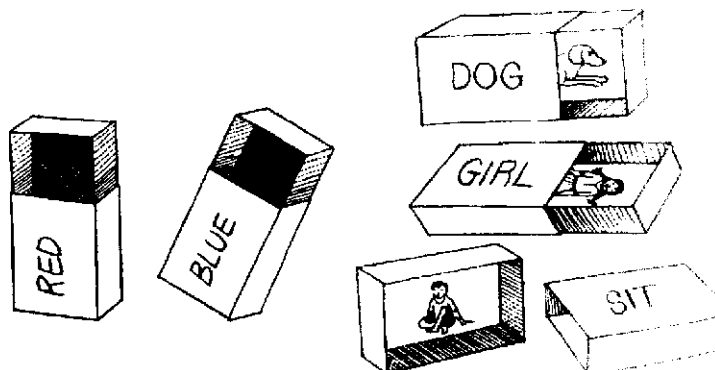


Ask children to bring empty matchboxes from their home. Stick white paper on the outer shells and inside drawers. Now write the number "1" on the outer shell. Draw one little circle inside the drawer. Write "one" on the back of the drawer. Do this for numerals 1 to 20. Remove the drawers from the matchboxes and make a pile of the matchbox cases and their drawers. Children can now put the drawers in their right shells. They can arrange the matchboxes in an ascending or descending order. Many number patterns can be discovered through these activities.

## WORD MATCHING

This activity gives children an opportunity to match words to their pictures.

This activity is quite similar to the number matching activity. On top of the matchbox shell you write the name of a common object. Inside the drawer you draw a picture of that thing. Then make a pile of matchbox word shells and picture drawers and ask children to match them.

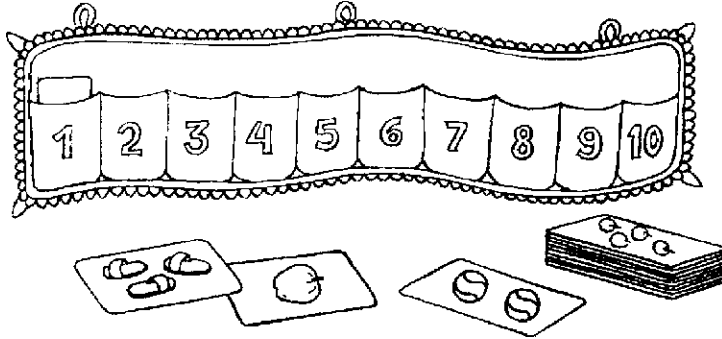


(Pix: Avinash Deshpande)



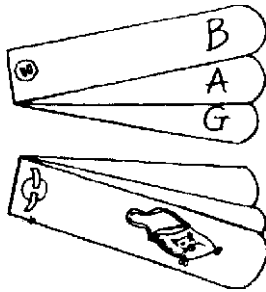
## NUMBER POCKETS

Little children find this activity great fun.

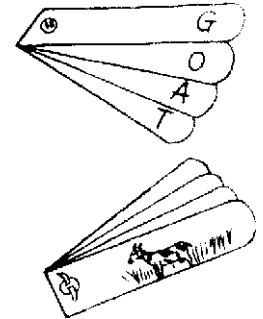


Make a cloth bag with ten pockets each numbered from 1 to 10. Make a pack of cards with different number of objects on them. Children pick up a card, count the number of things on it and place the card in the right “number” pocket.

## SPELLING FAN



These mini fans can help children remember the correct spelling of words. Take 2-cm x 8-cm rectangles of thick paper. Make a pile of three cards. Align them and then punch a hole near the centre of the left edge. Secure the cards together with the help of a split pin or a press button. Now write the letters **B**, **A** and **G** on the cards. Draw the picture of the bag on the back of the mini-book. These are self-correcting cards. Children can open up the fan, read the word and then invert the fan to see the picture.

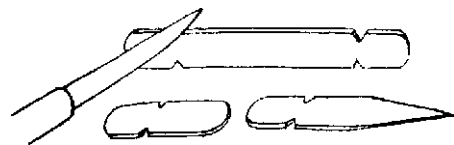


## FLICK KNIFE

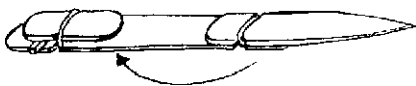
This automatic mechanical knife - a *Rampuri Chaku*, is fun to make and a sheer delight to play with.



1. To make the Flick Knife you will need two wooden ice-cream sticks, two small rubber bands, a matchstick and a paper knife or blade. Cut one ice-cream stick about 3-cm from one end.



2. Cut notches in the pieces as shown. Taper the long piece so that it looks like a knife blade. Cut notches on the other ice-cream stick too, as shown.

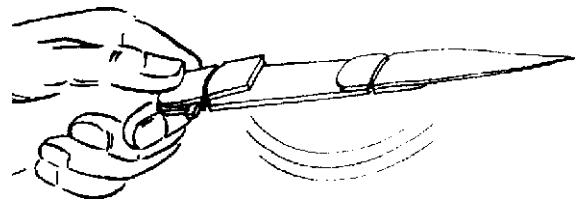


3. Join the cut pieces on the big ice-cream stick by putting a rubber band in each pair of notches. Slip in a piece of matchstick between the small piece and the big ice-cream stick. This is the fulcrum and is part of the locking system. You can open and close it by pressing it.

(Pix: Avinash Deshpande)

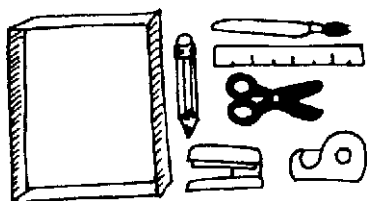


4. Now swing the blade and lock it under the small piece.

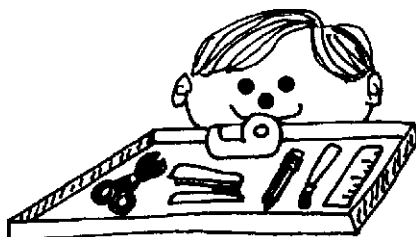


5. Now, if you press the left button, the blade will flick open in a fraction of a second.

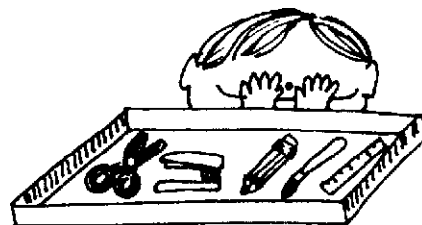
## WHAT IS MISSING?



1. You need a tray or a big *thali*, and lots and lots of different things.

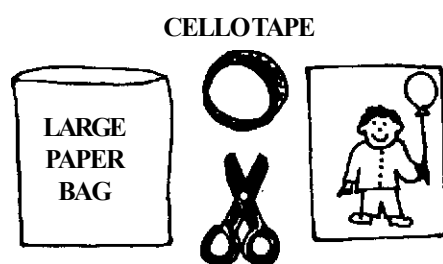


2. Lay different things on the tray. Let a friend have a good look at them.

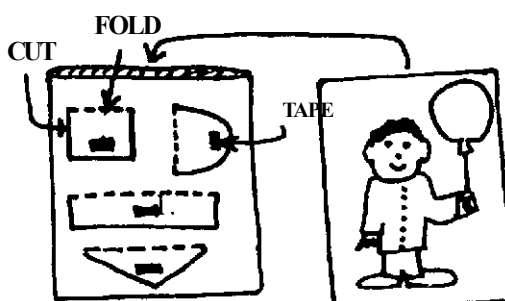


3. Then ask a friend to cover his eyes, while you remove one item from the tray. Ask your friend to open his eyes and find the missing item.

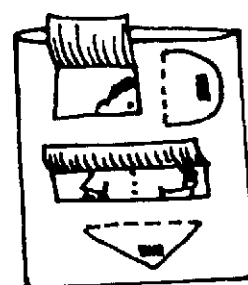
## PART AND WHOLE



1. Make a picture a on a sheet with markers. You could also use a picture from an old magazine.

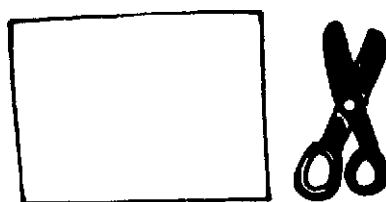


2. Now cut windows in a big brown envelope. Make hinged-window shutters with tape. Then slide the picture into the envelope.

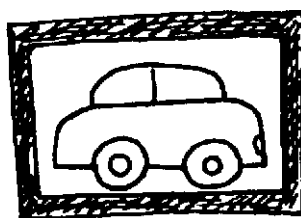


3. Let a friend peek at the picture through the windows and guess what it is.

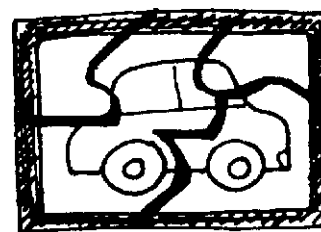
## SIMPLE JIGSAW



1. For making a jigsaw you will need an old file cover, sketch-pens and a scissors.



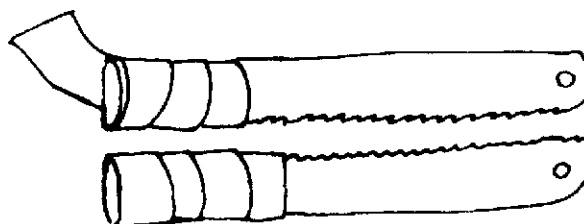
2. Draw a border around the cardboard. Then draw a picture on the cardboard.



3. Cut the picture into a few pieces. Ask a friend to assemble the jigsaw.

## BROKEN HACKSAW BLADES

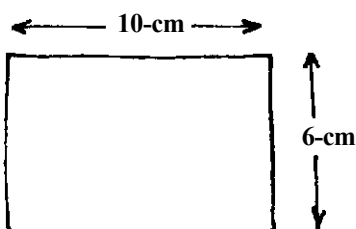
Do not throw away broken hacksaw blades. Wrap the raw ends with tape or an old cloth to make a handle. Cost of tools is often a reason why schools and homes have no workshops. In India broken hacksaw blades are often sharpened and made into very efficient cutting knives.



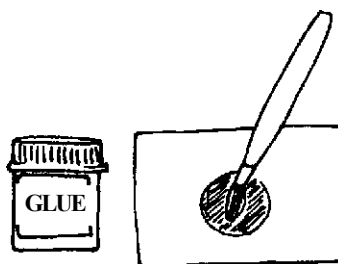
(Pix: MAKING THINGS by Ann Wiseman)

## SMELL WELL!

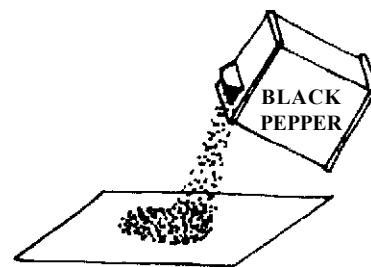
This is a nice game of smells. Use strong smelly stuff like pickles, *heeng*, peppermint, *pan masala*, *odomas*, *amrutanjan* etc. to make the experience interesting.



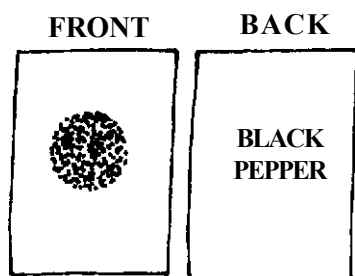
1. Take several thick 6-cm x 10-cm cards.



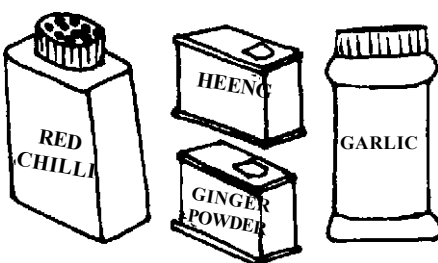
2. Paint a 3-cm circle of glue on the card.



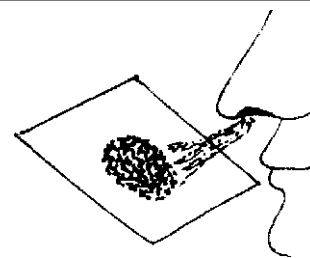
3. Sprinkle some black-pepper powder on the wet glue.



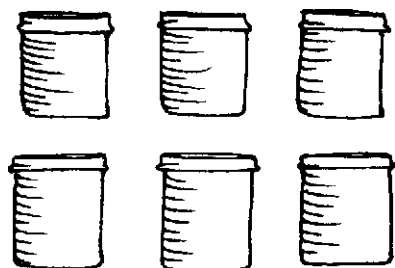
4. On the backside of the card write BLACK PEPPER.



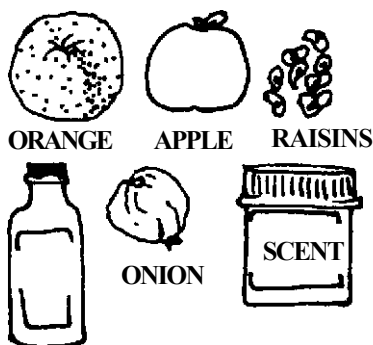
5. Make several cards with different powders having different smells.



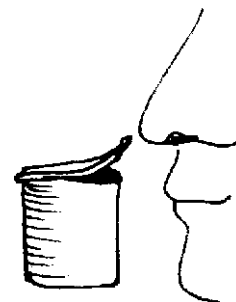
6. Let your friend smell each powder and guess its name. Cross check your guess by reading the name on the back.



7. Collect several black empty film roll bottles.



8. Put little bits of different foods into each case. Cover the lids tightly shut for several hours.

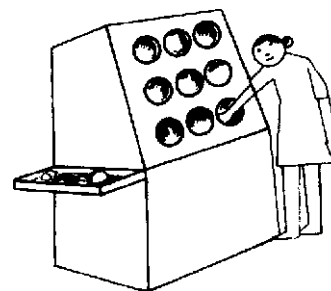


9. Ask your friends to guess the food by only smelling it. Carefully open the lid only a little so that the food inside cannot be seen.

## TOUCH AND TELL

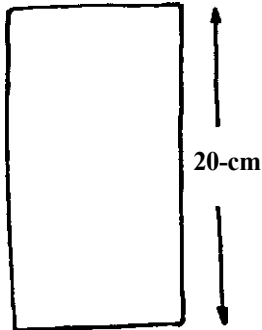
Hide things in drawers, so that children can't see them but they can put their hands inside the drawer and feel them. Children should be able to name things without seeing by "feel" alone. They should also be able to connect this experience with things they can spot in their surroundings.

(Pix: Vikram Sarabhai Community Science Centre, Ahmedabad)

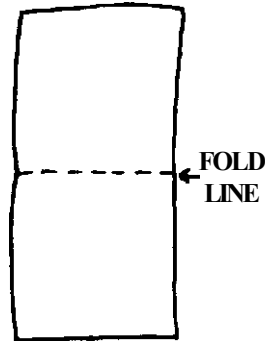


## MINI MOVIES

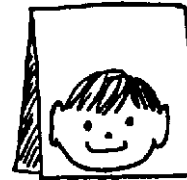
When a picture is removed from in front of your eyes, its image still lingers in the mind for a fraction of a second. A normal cinema reel uses a lot of frames to depict "action". But even two frames can give you a feel for simple animation.



1. Take a piece of paper 8-cm x 20-cm.



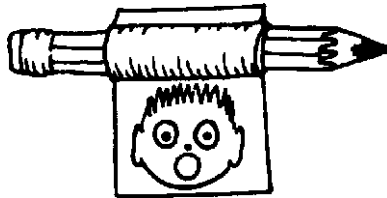
2. Fold the paper in half.



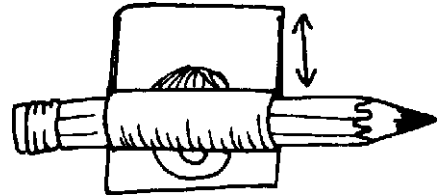
3. Think of an action which can be shown in two simple pictures. Draw one picture on the top sheet.



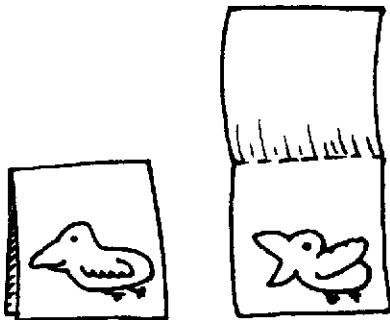
4. Draw the other picture directly below on the bottom sheet. Only change the part of the picture you want to see move.



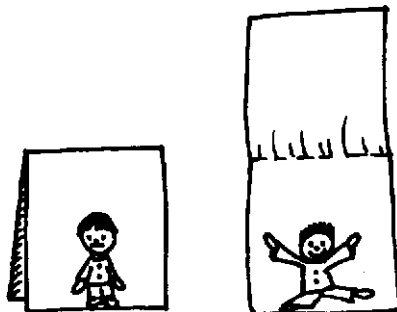
5. Roll the top sheet tightly around a pencil.



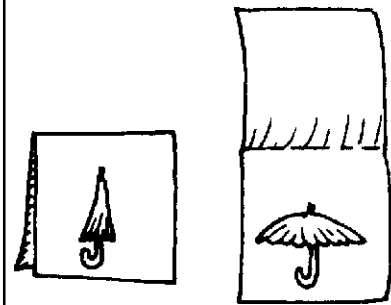
6. Move the pencil up and down quickly so that the top sheet rolls up and unrolls.



7. Make many more mini movies for example, make a bird fly...



8. ...or a boy jump....

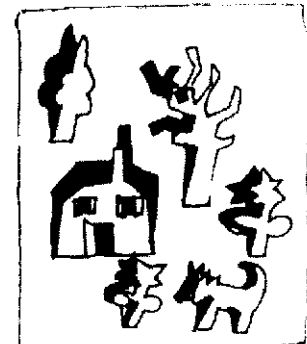
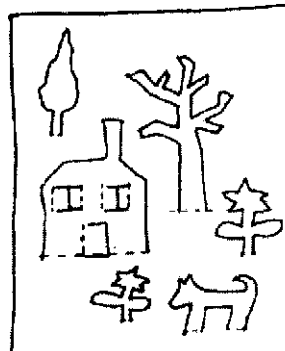


9. ...or open and close an umbrella.

## 3-DIMENSIONAL PICTURES

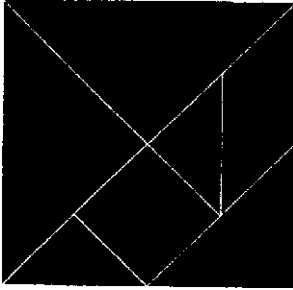
Use thick paper to make these 3-D pictures. Draw houses, trees, animals etc. Cut along the drawn lines except where things bend (dotted lines). Use a paper knife to cut. Finally bend shapes to make things stand. This is a good technique for making dioramas and cards. It is a good way to learn about perspective.

(Pix: MAKING THINGS by Ann Wiseman)





## ABC OF TANGRAMS



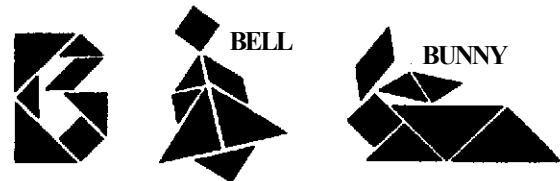
Tangrams come from China. They are thousands of years old. The Tangram is made by cutting a square into seven pieces. The puzzle lies in using *all seven* pieces of the Tangram to make birds, houses, boats, people and geometric shapes. In each case you have to use all the seven pieces - no more, no less.

Tangrams have fascinated mathematicians and lay people for years. You might be wondering why only the solutions are given. Well, you could just blacken the white lines to create the problems! Watch out, as Tangrams are known to be addictive. With these **Seven Little Wonders** the whole family can have hours of fun!



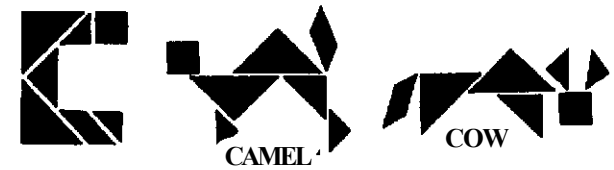
ARROW

ARCH



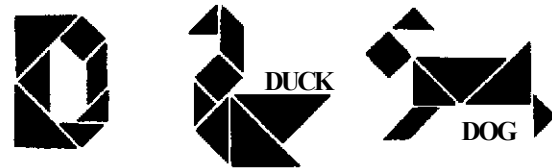
BELL

BUNNY



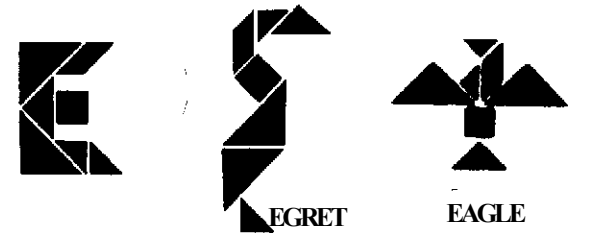
CAMEL

COW



DUCK

DOG



EGRET

EAGLE



FOUR

FAN



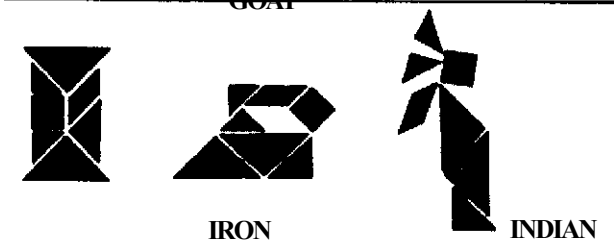
GOAT

GUN



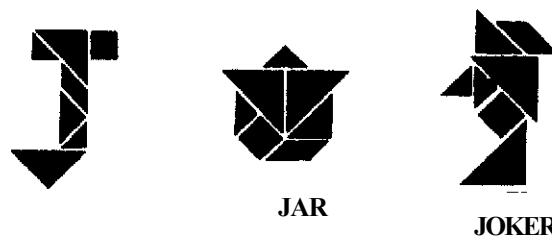
HORSE

HOUSE



IRON

INDIAN



JAR

JOKER



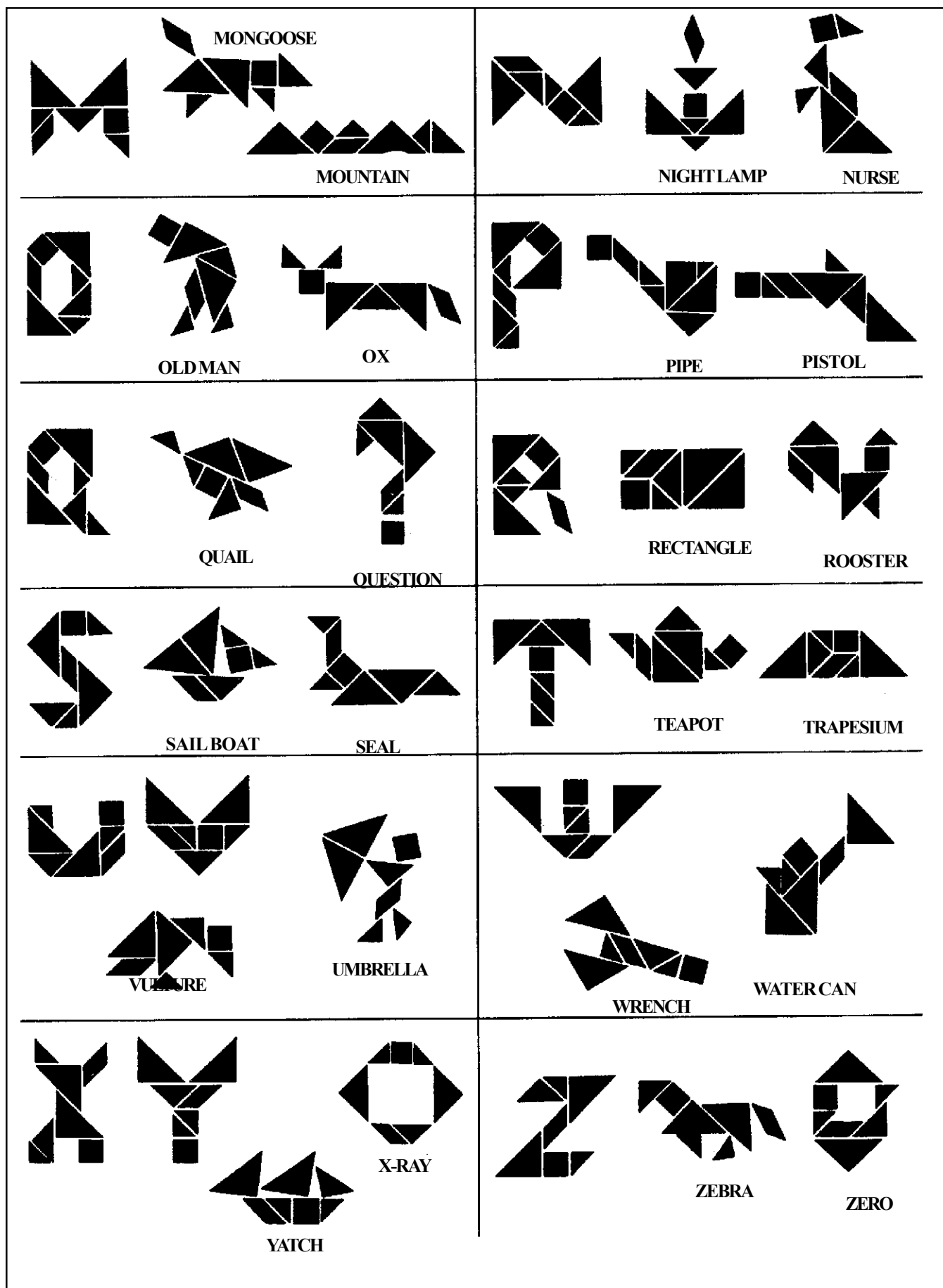
KANGAROO

KETTLE



LION

LADY



## MODELLING MATERIALS

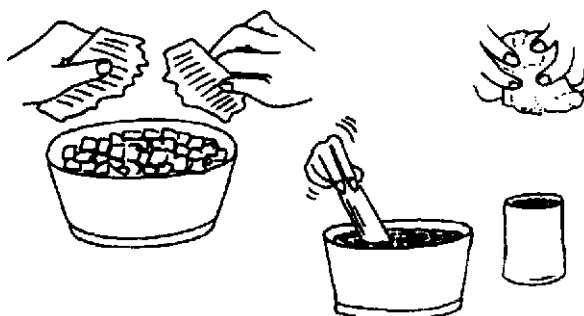
### FLOUR GLUE

Glue from wheat flour (*atta*). Sift flour to remove lumps. Maize or wheat flour is suitable. Mix the flour with water a little at a time to avoid lumps. It should be the consistency of thin cream. Cook the mixture gently until it thickens. Keep stirring to ensure the paste remains smooth and of even texture. Allow the paste to cool. Store in a closed container in a cool place for future use.



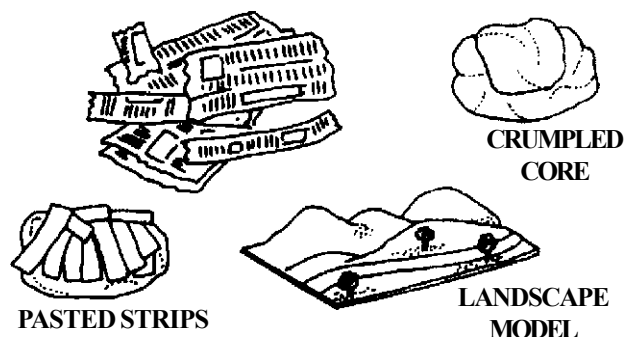
### PAPIER MACHE

Soak pieces of paper or card in water for half a day. Mash, grind, stir or pound the mix to a smooth fine pulp. Squeeze or press out excess water. Mix in a little glue (*fevicol*) or glue made from wheat flour, and work the material to a sticky modelling consistency.



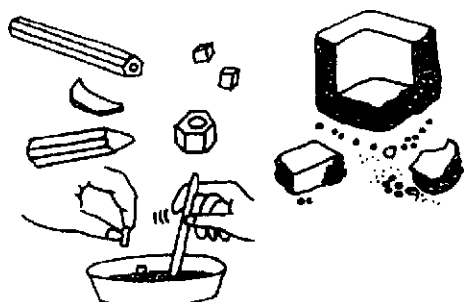
### PAPIER MACHE LAYERING

Soak small pieces, or narrow strips, of newspaper in paste. Use crumpled newspaper as a core or skeleton for the model. Build up the model in layers of strips and pieces. After drying, sandpaper smooth and paint and varnish.



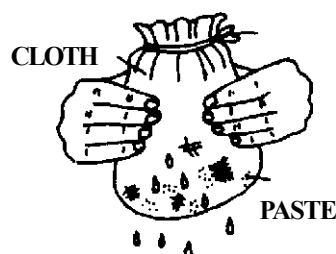
### POLYSTYRENE CEMENT

Dissolve polystyrene ball pen casings, or Styrofoam (thermocole) packing material in a little petrol. Natural rubber dissolved in petrol will make 'rubber' solution – another glue.



(VSO Science Teacher's Handbook)

### RICE GLUE



Cook one-part rice with 3-parts of water. Strain off excess water. Rice thickens as it cools. Squeeze the wet rice through open-weave cloth. Squeezing breaks down the rice grains and makes it into a paste. On cooling the rice paste forms a good glue.

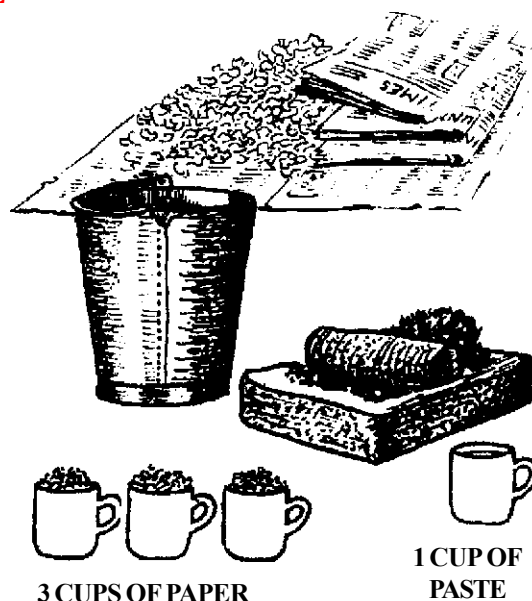
## PAPIER MACHE

Papier mache (pronounced as *Papeeay-mashay*) comes from the French, and means chewed paper. It is useful for making all sorts of models.

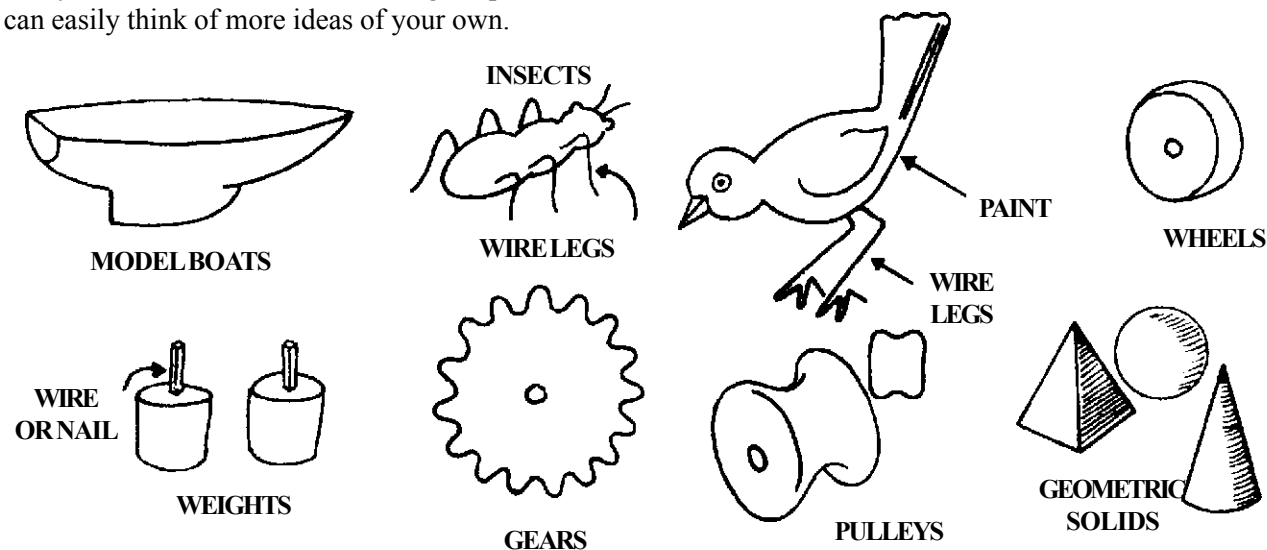
This is how you make it. You need paper and flour (*atta*) paste. Make the flour paste by mixing white flour or *maida* with water, put in enough flour to make it like thin curds. Cook it slowly until it boils, stirring well all the time.

Now tear up newspapers into pieces as big as postage stamps, and soak them in water for 24 hours. Then squeeze out the water and mash them on a grinding-stone. Mix the mashed paper with paste as shown:

1. Tear six newspapers into small pieces.
2. Soak them in a bucket for twenty-four hours.
3. Grind them on a grinding-stone.
4. Squeeze out all the moisture and mix with flour paste.



Many useful things for studying science can be made with papier mache. When it is dry it becomes very hard and does not break easily. Here are some ideas of making simple science models. You can easily think of more ideas of your own.



## FRICTION TOY

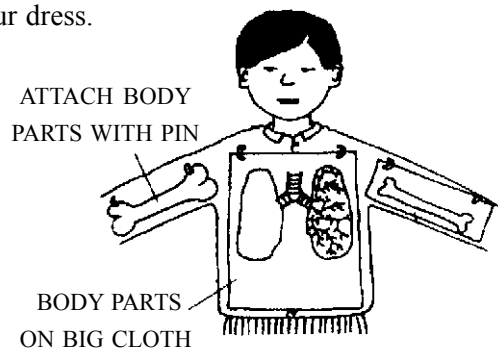
This toy is easy to make. It works on friction. Make some clay with mud and water. Make a lump of about 10-cm x 5-cm x 3-cm. When the clay is fairly dry, take a pencil and push it top at an angle, as shown in the picture. Poke from the bottom, again at an angle, so that the holes meet. Put a piece of string through the hole. When you hold the string tight the block won't move. When you hold the string loosely it slides down the string.

(Pix: David Horsburgh)



## DISPLAY DRESS

A nice way to learn about the human body - draw body parts on cloth and pin them up on your dress.





## PARROT'S TRAINING

This classic story - written by Indian Nobel Laureate Rabindranath Tagore in 1924, says it all.

Once upon a time there was a bird. It was ignorant. It sang all right, but never recited scriptures. It hopped pretty frequently, but lacked manners.

Said the Raja to himself: "Ignorance is costly in the long run. For fools consume as much food as their betters, and yet give nothing in return."

He called his nephews to his presence and told them that the bird must have a sound schooling. The pundits were summoned, and at once went to the root of the matter. They decided that the ignorance of birds was due to their natural habit of living in poor nests. Therefore, according to the pundits, the first thing necessary for this bird's education was a suitable cage.



The pundits had their rewards and went home happy.

A golden cage was built with gorgeous decorations. Crowds came to see it from all parts of the world.

"Culture, captured and caged!" exclaimed some, in a rapture of ecstasy, and burst into tears.

Others remarked: "Even if culture be missed, the cage will remain, to the end, a substantial fact. How fortunate for the bird!"

The goldsmith filled his bag with money and lost no time in sailing homewards.

The pundit sat down to educate the bird. With proper deliberation-he took his pinch of snuff, as he said: "Textbooks can never be too many for our purpose!"

The nephews brought together an enormous crowd of scribes. They copied from books, and copied from copies, till the manuscripts were piled up to an unreachable height.

Men murmured in amazement: "Oh, the tower of culture, egregiously high! The end of it lost in the clouds!"

The scribes, with light hearts, hurried home, their pockets heavily laden.

The nephews were furiously busy keeping the cage in proper trim.

As their constant scrubbing and polishing went on, the people said with satisfaction: "This is progress indeed!"

Men were employed in large numbers, and supervisors were still more numerous. These, with their cousins of all different degrees of distance, built a palace for themselves and lived there happily ever after.

Whatever may be its other deficiencies, the world is never in want of fault-finders; and they went about saying that every creature remotely connected with the cage flourished beyond words, excepting only the bird.

When this remark reached the Raja's ears, he summoned his nephews before him and said: "My dear nephews, what is this that we hear?"

The nephews said in answer: "Sire, let the testimony of the goldsmiths and the pundits, the scribes and the supervisors, be taken, if the truth is to be known. Food is scarce with the fault-finders, and that is why their tongues have gained in sharpness."

The explanation was so luminously satisfactory that the Raja decorated each one of his nephews with his own rare jewels.

The Raja at length, being desirous of seeing with his own eyes how his Education Department busied itself with the little-bird, made his appearance one day at the great Hall of Learning.

From the gate rose the sounds of conch-shells and gongs, horns, bugles and trumpets, cymbals, drums and, kettle drums, tom-toms, tambourines, flutes, fifes, barrel organs and bagpipes.

The pundits began chanting mantras with their topmost voices, while the goldsmiths, scribes, supervisors, and their numberless cousins of all different degrees of distance, loudly raised a round of cheers.

The nephews smiled and said: "Sire, what-do you think of it all?"

The Raja said: "It does seem so fearfully like a sound principle of Education!"

Mightily pleased, the Raja was about to remount his elephant, when the fault-finder, from behind some bush, cried out: "Maharaja, have you seen the bird?"

"Indeed, I have not!" exclaimed the Raja. "I completely forgot about the bird."



Turning back, he asked the pundits about the method they followed in instructing the bird.

It was shown to him. He was immensely impressed. The method was so stupendous that the bird looked ridiculously unimportant in comparison. The Raja was satisfied that there was no flaw in the arrangements. As for any complaint from the bird itself, that simply could not be expected. Its throat was so completely choked with the leaves from the books that it could neither whistle nor whisper. It sent a thrill through one's body to watch the process.

This time, while remounting his elephant, the Raja ordered his State Ear puller to give a thorough good pull at both the ears of the fault-finder.

The bird thus crawled on, duly and properly, to the safest verge of insanity. In fact, its progress was satisfactory in the extreme. Nevertheless, nature occasionally triumphed over training, and when the morning light peeped into the bird's cage it sometimes fluttered its wings in a reprehensible manner. And, though it is hard to believe, it pitifully pecked at its bars with its feeble beak.

"What impertinence!" growled the kotwal.

The blacksmith, with his forge and hammer, took his place in the Raja's Department of Education. Oh, what resounding blows! The iron chain was soon completed, and the bird's wings were clipped.

The Raja's brothers-in-law looked back, and shook their heads, saying: "These birds not only lack good sense, but also gratitude!"

With textbook in one hand and the baton in the other, the pundits gave the poor bird what may fitly be called lessons! The kotwal was honoured with a title for his watchfulness and the blacksmith for his skill in forging chains. The bird died. Nobody had the least notion how long ago this had happened. The fault-finder was the first man to spread the rumour.

The Raja called his nephews and asked them: "My dear nephews, what is this that we hear?"

The nephews said: "Sire, the bird's education has been completed."

"Does it hop?" the Raja enquired.

"Never!" said the nephews.

"Does it fly?" "No."

"Bring me the bird," said the Raja.

The bird was brought to him, guarded by the kotwal and the sepoy. The Raja poked its body with his finger. Only its inner stuffing of book-leaves rustled.

Outside the window, the murmur of the spring breeze amongst the newly budded Asoka leaves made the April morning wistful.

(Pix: Kamiriithu)

## THE MAN WHO LOVED NUMBERS

An unusual story of a great mathematician.

Paul Erdős was the most prolific mathematician of all time. "The first sign of senility," Erdős often said, "is when a man forgets his theorems. The second sign is when he forgets to zip up. The third sign is when he forgets to zip down." Erdős never experienced the first sign. He managed to think about more problems than any other mathematician in history and could recite the details of all 1,475 of the papers he had written or co-authored. Fortified by coffee and amphetamines, Erdős did mathematics 19 hours a day, seven days a week. "A mathematician," Erdős was fond of saying, "is a machine for turning coffee into theorems." When friends urged him to slow down, he always had the same response: "There'll be plenty of time to rest in the grave." Erdős, to be sure, always spoke in aphorisms.



*Life* magazine said of Paul Erdős that "he felt about numbers the way some people feel about their children: He loved them unreservedly, but he could not completely understand them, no matter how assiduously he applied his formidable intelligence to the task. And while he had no children—indeed, no wife, no job, no hobbies, not even a home of his own—numbers returned his love, revealing their secrets to him as they did to no other mathematician this century. For six decades, living out of a single ratty suitcase, he criss-crossed four continents at a frenzied pace, moving from one university or research centre to the next, in search of good mathematical problems and fresh mathematical talent. His modus operandi was to show up on the doorstep of an esteemed mathematician, declare, "My brain is open," work with his host for a day or two, until he was bored or his host was run down, and then move on to another home. Erdős's motto was not "Other cities, other maidens" but "Another roof, another proof." Maidens, in fact, were rarely on Erdős's mind: He was celibate his entire life. Mathematics was his only love.

Paul Erdős was born in Budapest on March 26, 1913, the son of two high school math teachers. While his mother, Anna, was giving birth to him, her two daughters, ages three and five, contracted septic scarlet fever and died within the day. Of the three children, the girls were considered to be the smart ones. When Erdős was one and a half, his father was captured in a Russian offensive and sent to Siberia for six years. Until he reached his teens, Erdős's mother kept him out of school, fearing that it was the source of childhood contagion.

Home alone, with time on his hands, Erdős did mental arithmetic. At three he could multiply three-digit numbers in his head and amuse visitors by asking their ages and computing how many seconds they had lived. At four he started looking for patterns to the prime numbers, integers like 2, 3, 5, 7, 11, and 17, which are evenly divisible only by themselves and the number 1. From then on he was hooked on a life of the mind. He became a mathematical monk, renouncing physical pleasure and material possessions for an ascetic, contemplative life, a life devoted to a single narrow mission: uncovering mathematical truth.

It was also a life torn asunder by some of the major political crises of the twentieth century. "I remember an incident when I was six," Erdős recalled. "Jews in Hungary had lots of problems after the Communist revolution in 1919. Being a Jew, my mother once said to me, 'You know the Jews have such a difficult time, shouldn't we get baptised?' I told my mother, 'Well, you can do what you please, but I remain what I was born.'" Erdős would leave Budapest before the Nazis moved in. Although his mother survived the war, the Nazis killed four of her five siblings and Erdős's father died of a heart attack.

Erdős never felt at home in any country. Everywhere he went he had trouble with political authorities. During the McCarthy era the U.S. denied him a re-entry permit because they feared he was a Hungarian spy, Stalinist Hungary harassed him because of his long stays in the U.S. Mathematics was his escape from a hostile world.

## HOW TO REACH THE SUN... ON A PIECE OF PAPER

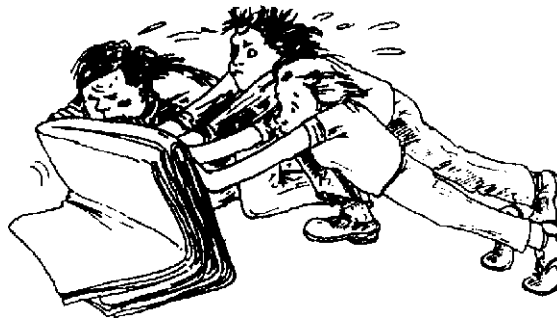
A poem by - Wes Magee

Take a sheet of paper and fold it,  
and fold it again,  
and again, and again.  
By the 6th fold it will be 1-centimeter thick.

By the 11th fold it will be  
32-centimeter thick,  
and by the 15th fold - 5-meters.

At the 20th fold it measures 160-meters.  
At the 24th fold - 2.5-kilometers,  
and by fold 30 it is 160-kilometers high.  
At the 35th fold it is 5000-kilometers.  
At the 43rd fold it will reach the moon.

And by the fold 52  
will stretch from here  
to the sun!  
Take a piece of paper.  
Go on.  
TRY IT!



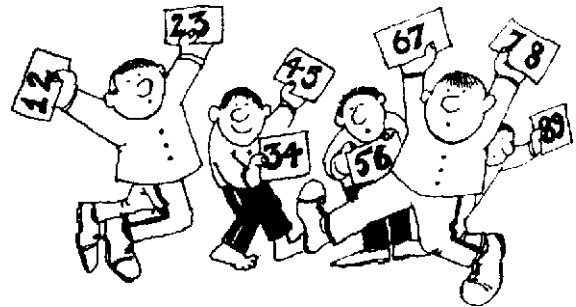
## UP TO 100

Here's an unusual game for just two players. It's called "Up to 100" and it's simple to learn but exciting. If you play the game with a friend, get him to start. He has to begin by writing down any number from 1 to 10 on a piece of paper. You then write down a second number, again it can be any number from 1 to 10, and add the two numbers together. He then writes down the third number, again any number from 1 to 10, and adds this to the first two. You can continue doing this, with each of you taking it in turns to add a number to the total. The player who adds the final number that makes the total add up to exactly 100 is the winner.

And if you like winning, you'll be pleased to know that you can win this game EVERY TIME!

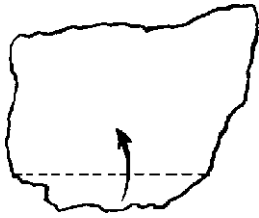
All you have to do to win is this:

Make sure that at the end of one of your moves the total is either 12 or 23 or 34 or 45 or 56 or 67 or 78 or 89. Once you have reached one of these numbers, your worries are over, because all you have to do then is play numbers which, when added to your opponent's last number, makes 11. Once you reach 89 it doesn't matter what number he calls, you can always add whatever it takes to hit 100.

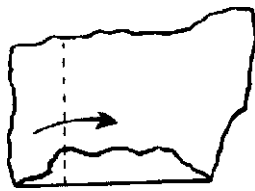




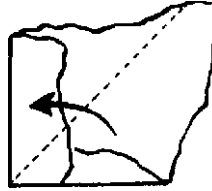
### SQUARE FROM ANY TORN PAPER



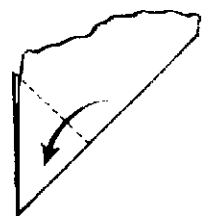
1. Make a fold in the paper.



2. You now have a straight folded edge. Fold part of this edge back on itself.



3. You now have a second folded edge at right angles to the first edge. Fold these two edges together.



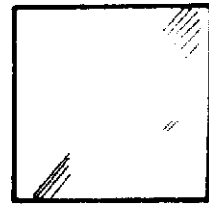
4. Fold the diagonal edge back on itself ...



5. ... like this. Turn over.

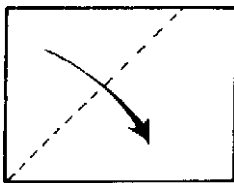


6. Cut parallel to the horizontal straight edge, just above it. Unfold the paper and discard the shaded portion.

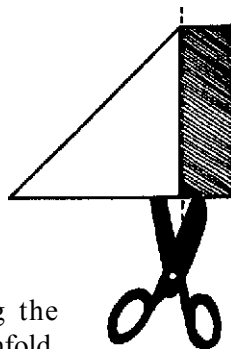


7. You now have a perfect square.

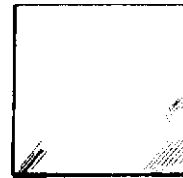
### SQUARE FROM A RECTANGLE



1. Fold the side of the rectangle to the bottom edge.

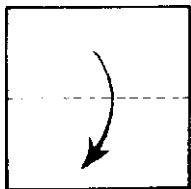


2. Cut along the dotted line. Unfold.

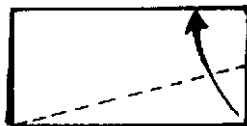


3. To get a square.

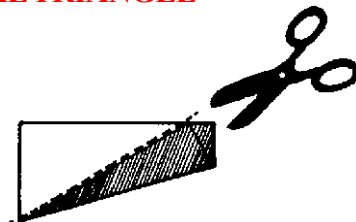
### EQUILATERAL TRIANGLE



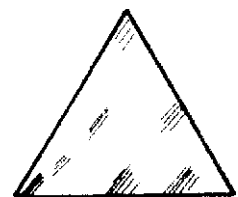
1. Fold the top edge of the square to the bottom edge.



2. Fold the bottom right corner to the top, making sure that the crease line starts from the bottom left corner.



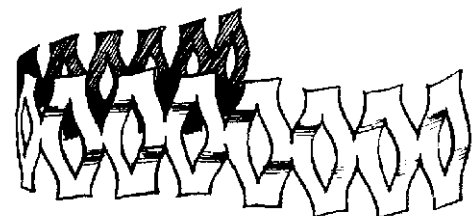
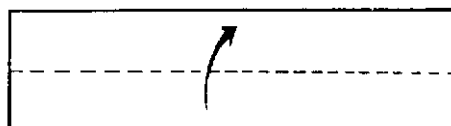
3. Cut along the dotted line. Discard the shaded area and unfold.



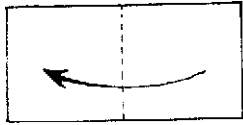
4. To get a regular equilateral triangle.

### PAPER CHAIN

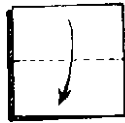
Fold a long strip into half. Make alternative cuts in the top and bottom edges. Open it to see a chain.



## DIAMOND



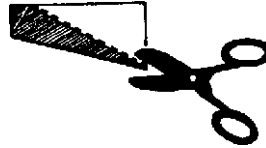
1. Fold a rectangle of paper (2 x 1) into half.



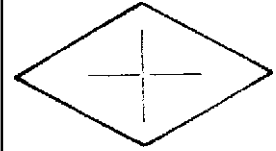
2. Fold top to bottom.



3. Fold the bottom left corner up to the top as shown.

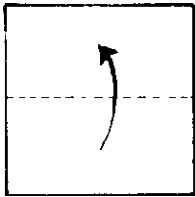


4. Cut. Discard the shaded area and unfold.

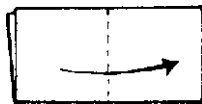


5. To get a lovely diamond shape.

## CROSS



1. Fold a paper square in half.



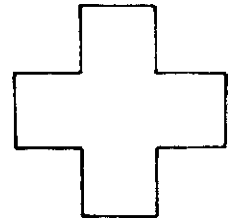
2. Fold in half from left to right.



3. Fold the upper layer diagonally in half. Turn over and do the same behind.

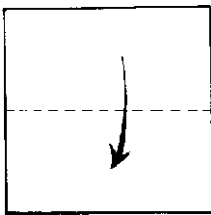


4. Cut at right angles to the top edge. Discard the shaded area and unfold.

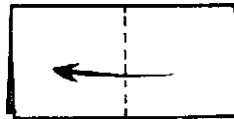


5. The cross.

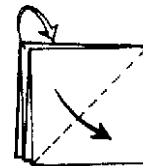
## OCTAGON



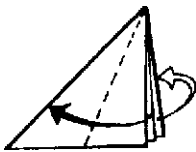
Fold a square in half from top to bottom.



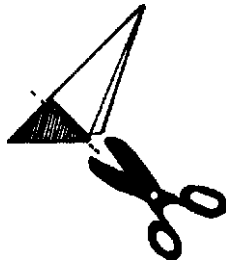
2. Fold in half from right to left.



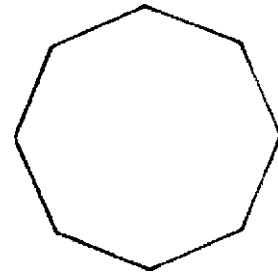
3. Fold the upper layer diagonally in half. Turn over and do the same behind.



4. Fold the vertical edges (two layers) to the diagonal edge at left. Turn over and fold the remaining vertical edge to the diagonal edge.

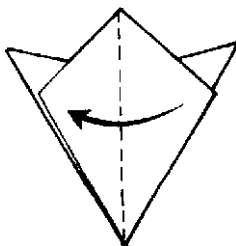


5. Cut along the edge. Discard the shaded area and unfold.

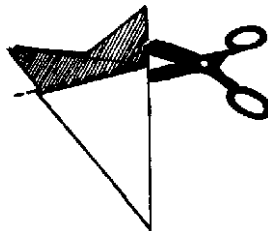


6. The octagon.

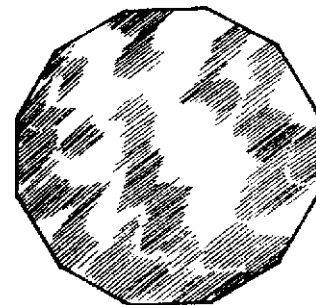
## TWELVE-SIDED FIGURE



Start by folding steps 1 - 4 of the hexagon (page 22).  
1. Fold in half from right to left.

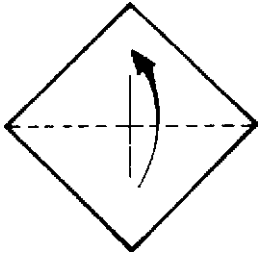


2. Cut along the edge. Discard the shaded area and open up.



3. The twelve-sided figure.

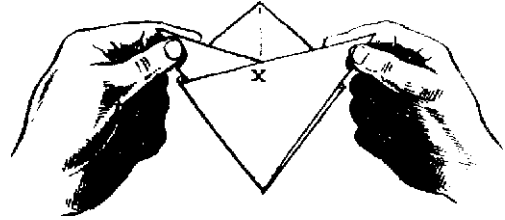
## HEXAGON



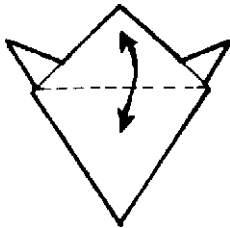
1. Fold the two opposite corners of a square.



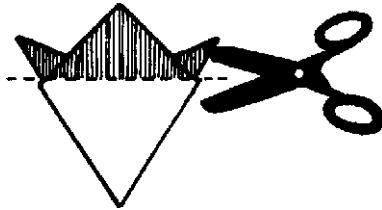
2. Making sure that the creases start from the centre of the folded edge, bring the two side points forward to lie across each other.



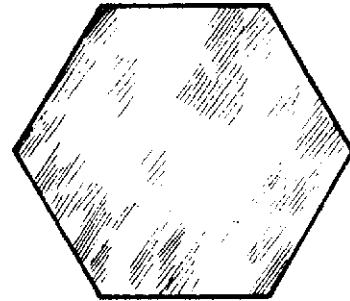
3. Carefully pull the points apart so that the angle where the edges of the two flaps meet (point X) is in line with the vertical centre crease. Now crease firmly and turn over.



4. Fold the top point as far as it will go, crease and return.



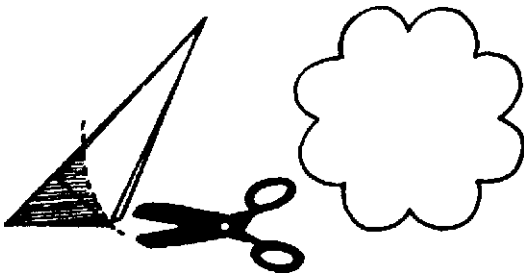
5. Cut along the crease line you have just made. Discard the shaded portion and open up.



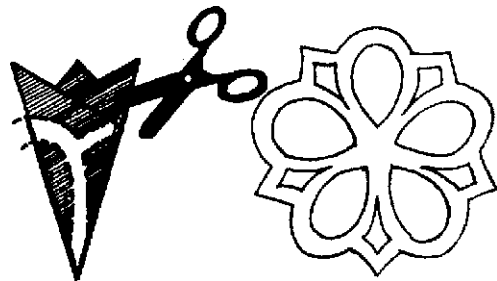
6. To get the six-sided Hexagon.

## PAPER PATTERNS

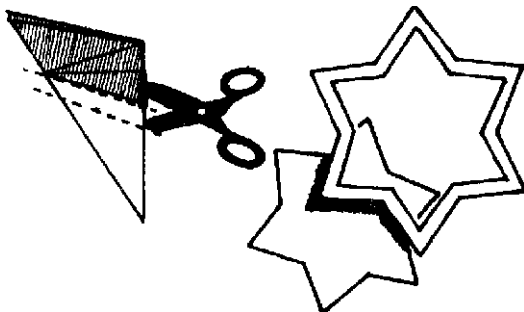
First fold a paper several times. Then by making some extra cuts or altering the direction of cuts you could prepare interesting paper patterns.



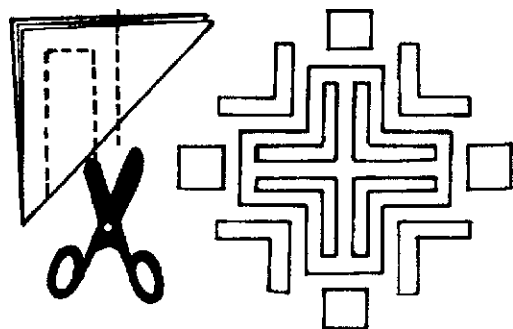
1. Instead of a straight line cut a curved cut on a 8-fold paper will make a flower with eight petals.



2. A few straight and curved cuts will make a flower and leaf design.

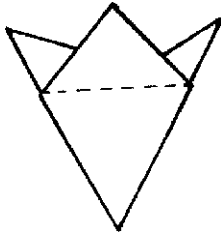


3. If the first cut is followed by a second parallel cut as shown, then the paper will unfold into two similar shapes - one "hollow" and the other "solid".

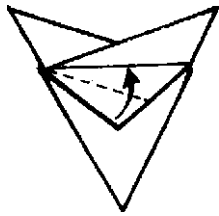


4. One straight cut followed by a few further cuts will generate a perforated shape as shown.

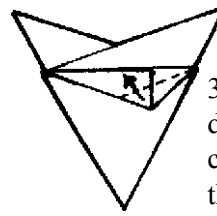
## SIX-POINTED STAR



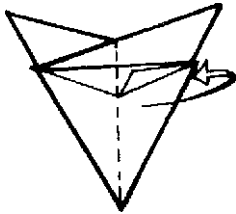
Start by folding steps 1-3 of the hexagon (p22).  
1. Fold the top point down as far as it will go.



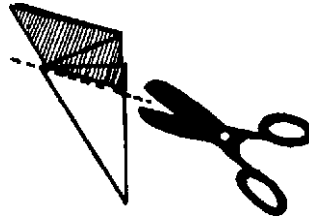
2. Fold one of the diagonal edges of the central triangle to the horizontal edge.



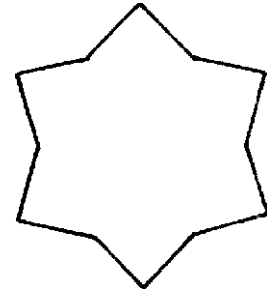
3. Fold the other diagonal edge of the central triangle to the horizontal edge.



4. Fold in half by taking the right side behind.

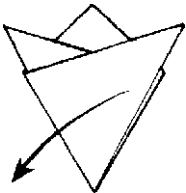


5. Cut along the edge. Discard the shaded area and unfold.

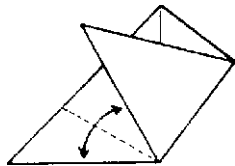


6. The six-pointed star.

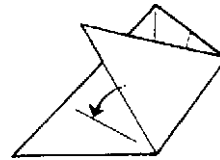
## FIVE-POINTED STAR



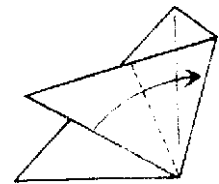
Start by folding steps 1-3 of the hexagon.  
1. Start by unfolding the uppermost flap.



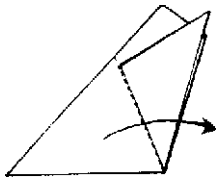
2. Fold the bottom edge to the diagonal edge. Make a crease and open flat again.



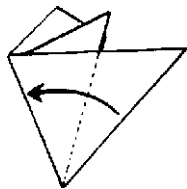
3. Now reposition the triangular flap so that its lower edge lies along the crease made in the previous step.



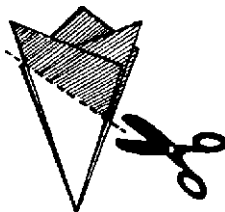
4. Then fold the flap in half.



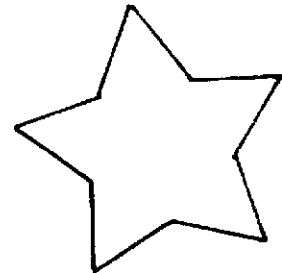
5. Fold the left point across the folded edge.



6. Bring the flap back to the left.

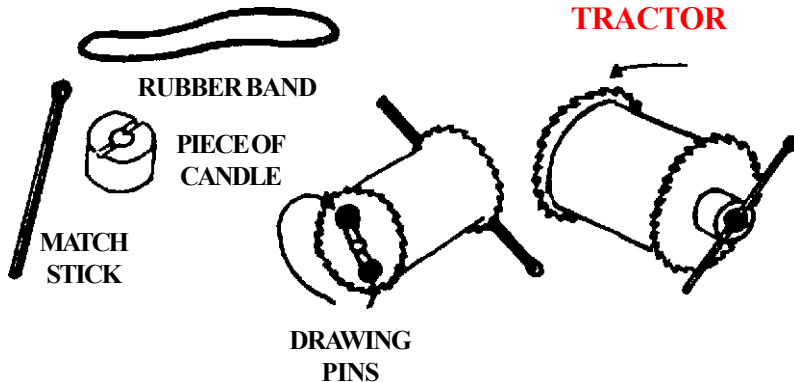


7. Cut from a point about halfway down the right edge to where several folded edges meet at left. Then discard the shaded area and open up.



8. The five-pointed star.

## TRACTOR



This simple tractor can move up a slope!

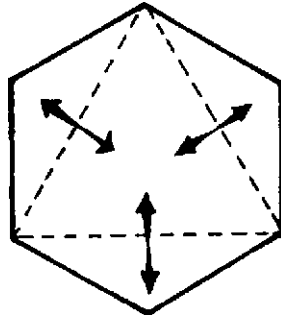
Weave the rubber band through the reel from matchstick to the drawing pins. Wind up the rubber band by rotation the matchstick, and then keep it on an inclined surface to climb.

(Pix: David Horsburgh)

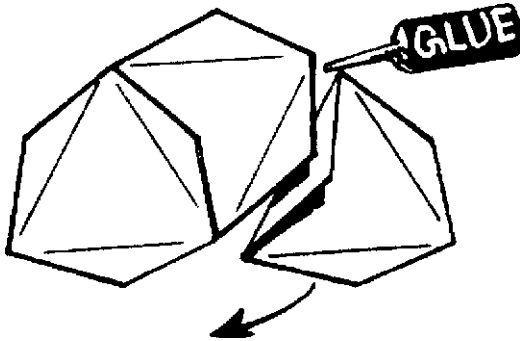
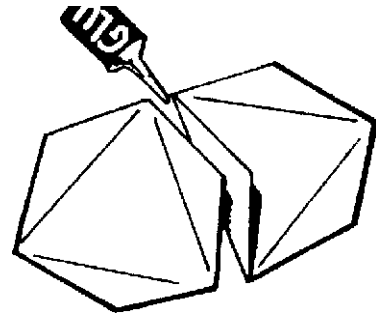
## PAPER BALL

You will need 20 hexagons (page 22) and glue, to make this Paper Ball.

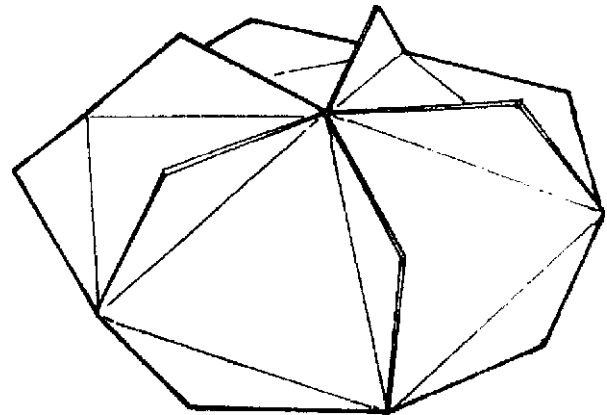
1. Take one hexagon and fold every other one of its corners to the centre. Make firm creases, then let the little triangular flaps so formed stand at right angles to the main area. Do the same with four more pieces.



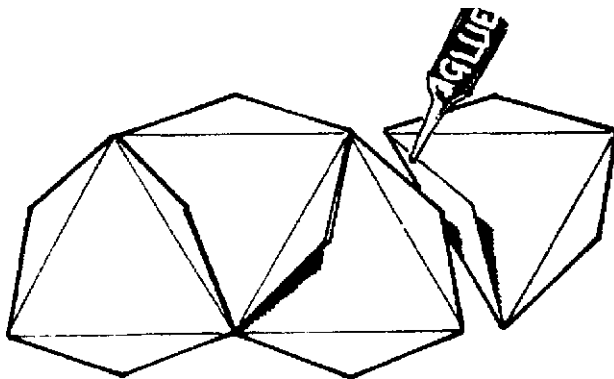
2. Join two pieces by gluing the outer sides of two flaps together.



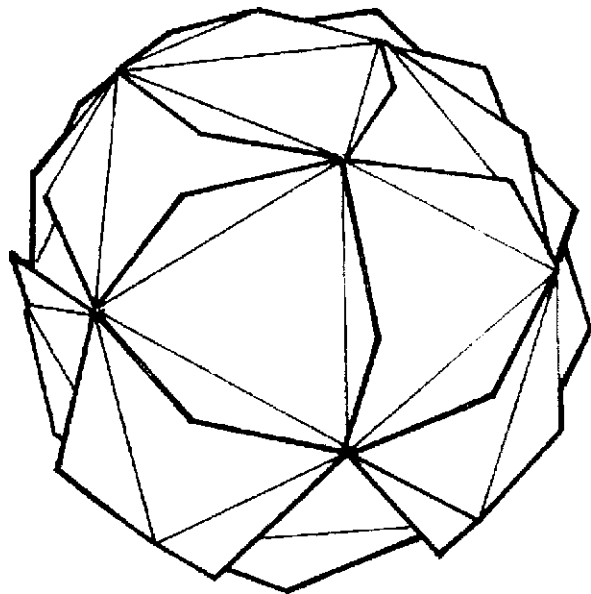
3. Similarly glue a third piece to the first two. Add two more pieces (following direction of the arrow in the diagram) with the fifth piece glued also to the first piece...



4. ... to complete a standing structure which has five triangular sides with little flaps in between. Make another such structure using 5 more hexagons.



5. Now make a chain by gluing the remaining ten hexagons together in line. Note that the first three pieces are joined as shown in step 3 but the fourth piece is differently placed. Glue the two ends of the chain together. Then glue the top and bottom sections in place.



6. The completed twenty-piece ball.

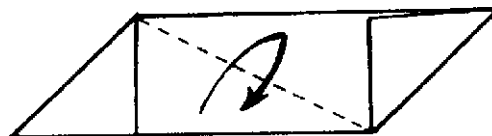


## WOVEN BALL

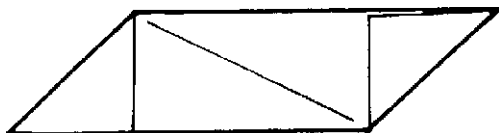
For this ball you will need lots of 1 x 4 strips of stiff paper (about 2-cm x 8-cm).



1. Fold the ends of one strip to the top and bottom edges as shown.

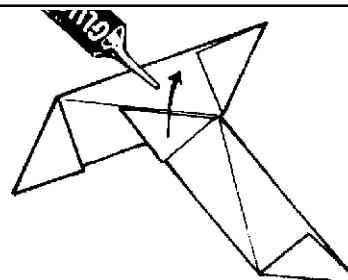


2. Fold the paper on a line between the corners of the two flaps, make a crease and open up...

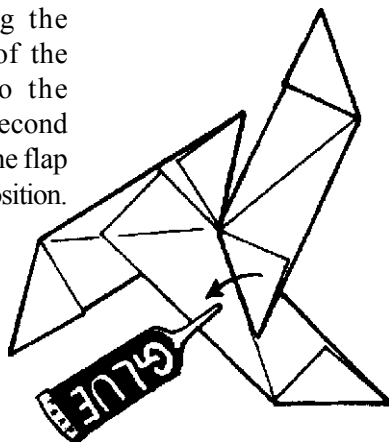


3. ...like this. Do the same with two more strips.

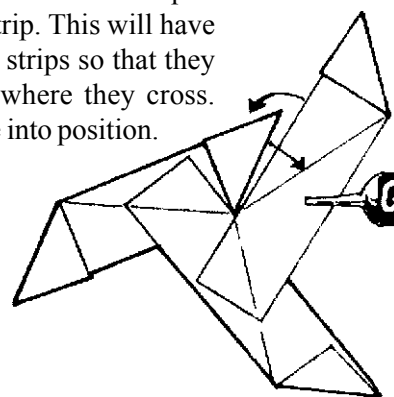
4. Bring the folded edge of one strip to the central crease of another. Unfold the flap and glue in position.



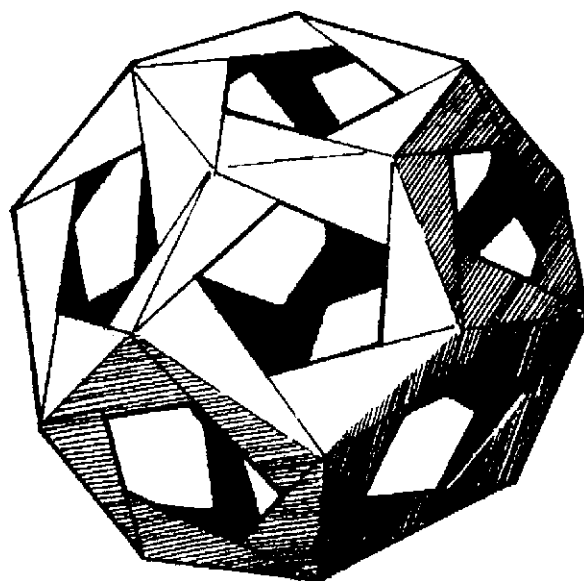
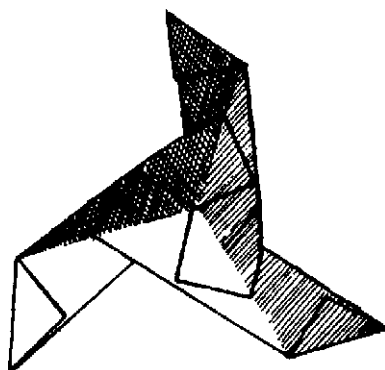
5. Now bring the folded edge of the third strip to the crease of the second strip. Unfold the flap and glue into position.



6. Bring the folded edge of the first strip to the crease of the third strip. This will have the effect of raising the strips so that they form a shallow 'dish' where they cross. Unfold the flap and glue into position.



7. This three-cornered structure will form one corner of the final model. Prepare two more strips by completing steps 1-3 and join them to one of the arms in the same way as shown in steps 4-6. This completes a second corner. Prepare more strips and join them similarly to other arms of the growing structure, gradually building it up...



8. ... until the ball is completed.

## FUN WITH SEEDS

Chew your fruit  
And smack your lips  
But do not throw  
The stones and pips.

After munching  
Pear or peach  
Keep their seeds  
Within your reach.

Seeds are white  
Seeds are brown  
Pine cones make  
A lovely crown.

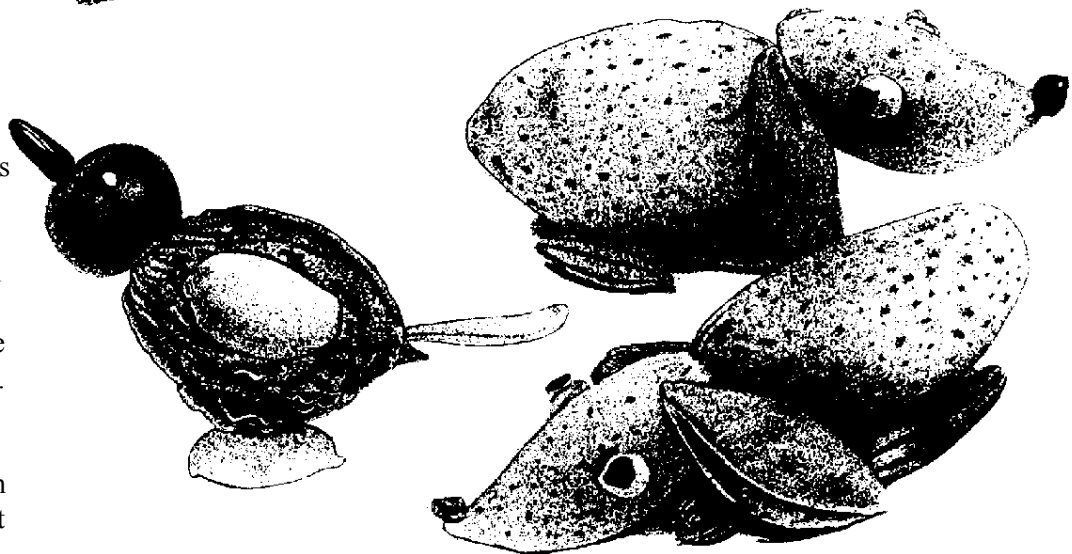
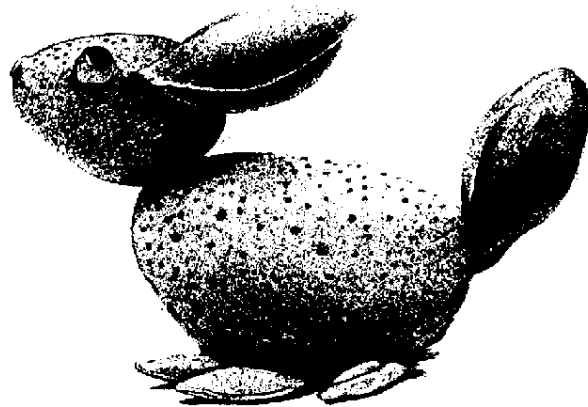
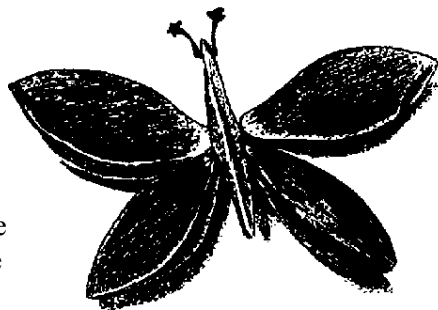
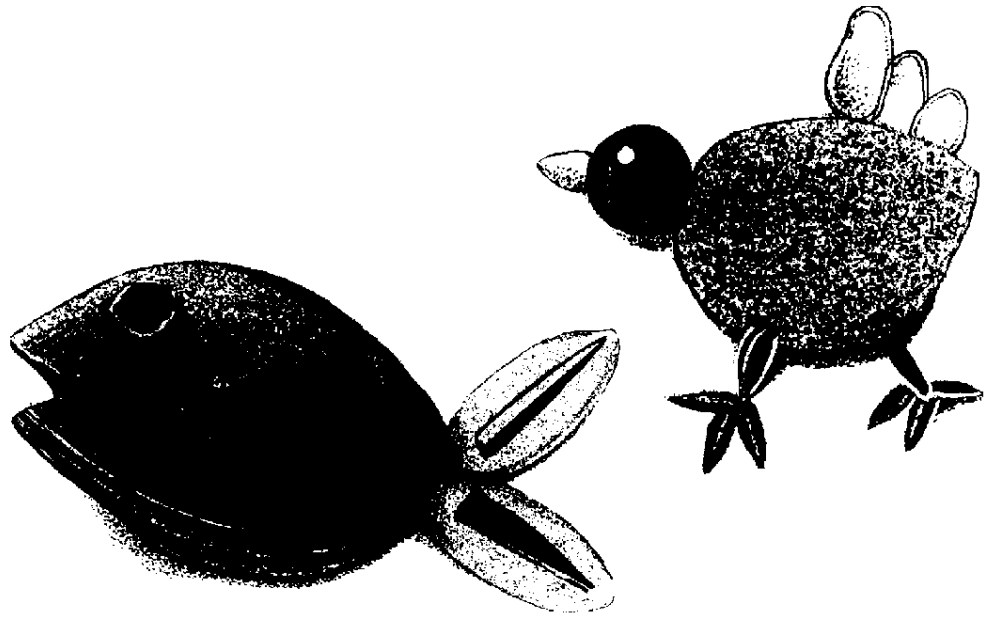
Sort the seeds  
Big or small  
Little animals  
Make them all.

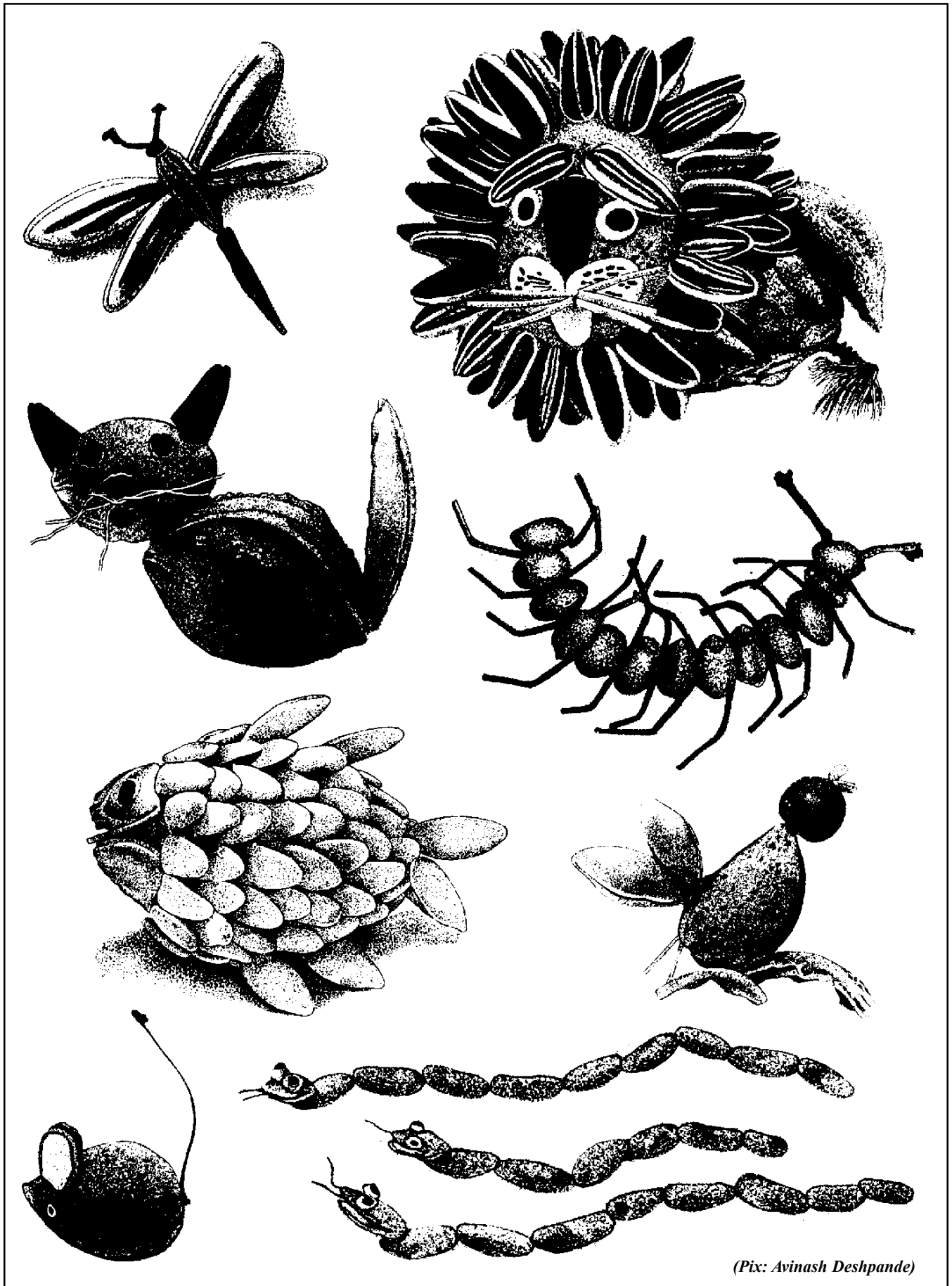
Date seeds have  
A longish shape  
Line them up  
To make a snake

Hard seeds make  
a lovely mice  
Some make penguins  
Which are nice.

Stick seeds on seed  
And sculpt a beast  
Make lots if you like  
Make some at least.

Scratch your head  
Try Winnie the Pooh  
Some day you might  
Just make a zoo!





(Pix: Avinash Deshpande)

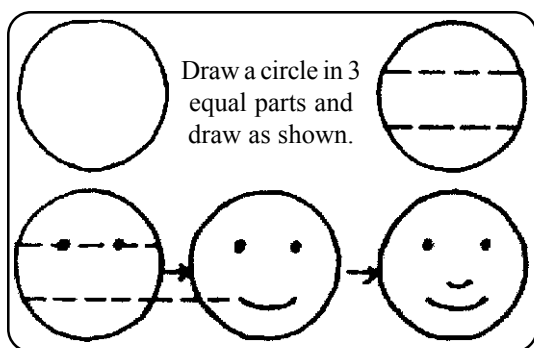
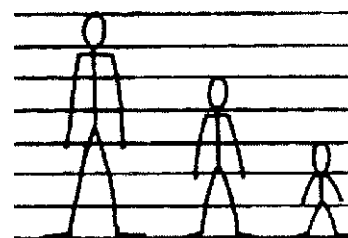
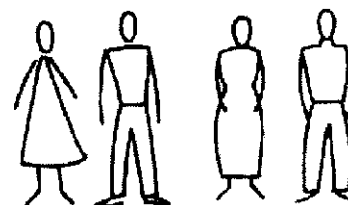
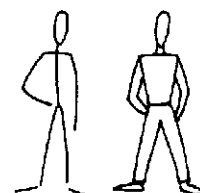
## LOOK AT THAT!

A picture is worth a thousand words. Children think in pictures, not words. Every educator must know how to draw. Simple matchstick drawings make things more lively and easier to comprehend.

Matchstick people are easy to draw and a lot of situations can be depicted using them. Draw a matchstick person first and then fill the limbs out by drawing tubes around them.

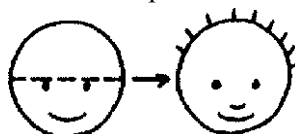
Alternatively, sketch people using a triangle as a basic shape for men and women.

When drawing adults, make the head and the body the same length as the legs. Draw the arms straight first. Draw them to come down below the top of the legs. Do not draw figures with too much detail, for example with noses, ears and so on. To draw adults, children and babies in proportion, notice how many times the head fits into the body. It is a good idea to exaggerate movement when drawing matchstick people. Join up all the lines of the body. Otherwise it may lead to confusion.

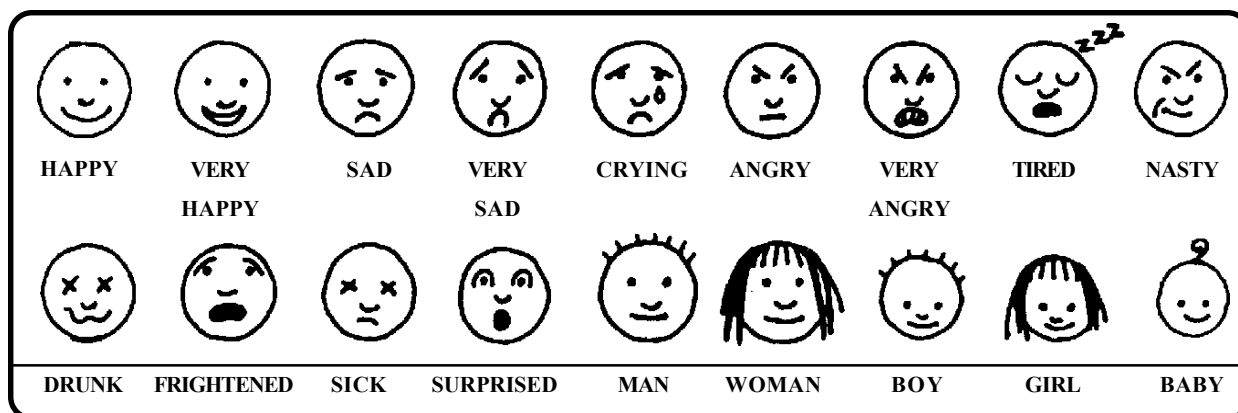


Draw a circle in 3 equal parts and draw as shown.

Draw a simple face.

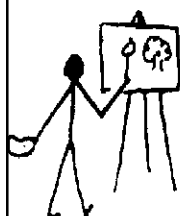


Draw a bicycle.



(HOW TO MAKE AND USE VISUAL AIDS - Nicola Harford and Nicola Biard, VSO)

**The Blackboard Book** by Eleanor Watts (Orient Longman, Hyderabad) shows amazing possibilities of depicting things, people, actions and experiences with simple matchstick strokes. A must for every teacher.



ARTIST



BARBER



MASON



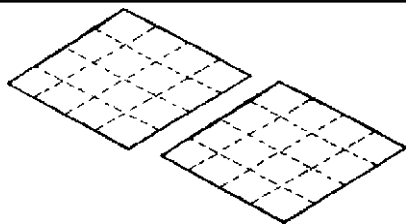
CARPENTER



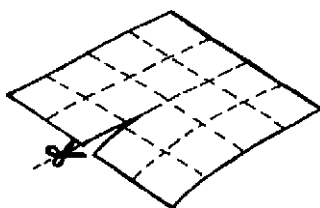
CHEMIST

## THE NEVER ENDING BOOK

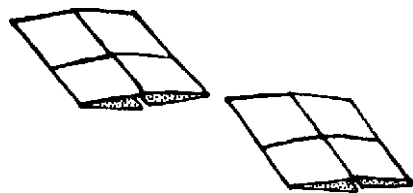
You could flip this fourteen-page book from start to end, and then automatically return to the start!



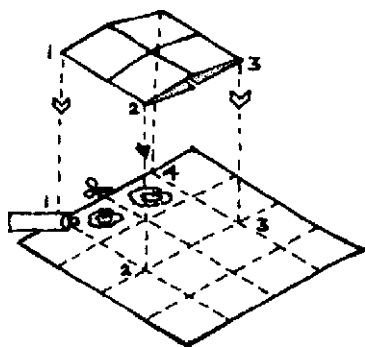
1. Fold 16 small, equal sized squares in two squares (10-cm). They will look like 4 x 4 pieces.



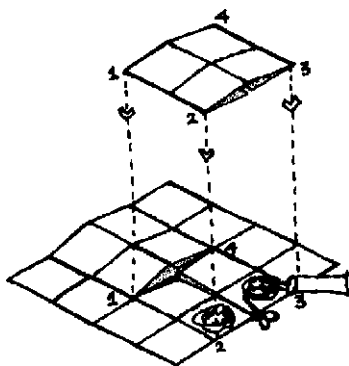
2. Take one 4 x 4 piece and cut it along the midline to make two 4 x 2 pieces.



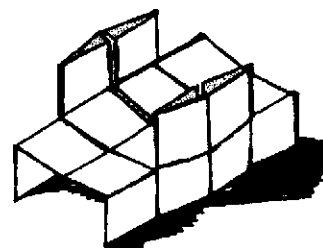
3. Fold the doors of both 4 x 2 pieces.



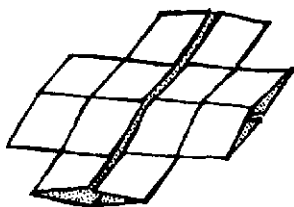
4. Take the other 4 x 4 square and cut it along the midline only up to the centre point. Apply glue to the two little squares and stick one 4 x 2 piece as shown.



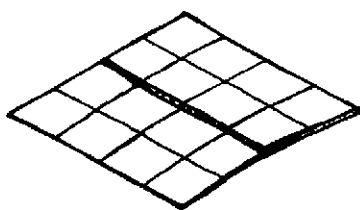
5. Again cut the midline from the other end to the centre point. Apply glue on the two little squares as shown, and stick the second 4 x 2 piece in place. The flexagon is complete now.



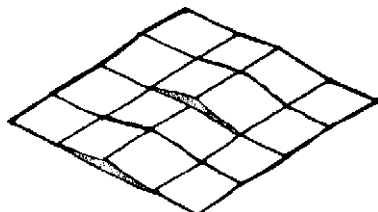
6. The assembly shows two 4 x 2 beds, placed side-by-side. The two 4 x 2 pieces have their folded doors facing each other.



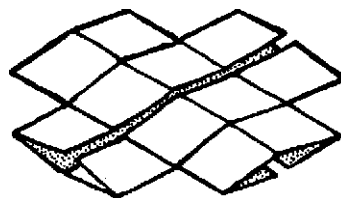
7. Now hold the tips of the head and foot rest and fold them outwards to get a flat, cross shape.



8. On opening out the middle flaps of the cross there will be a flat formation with 16 little squares in it. You can start your 14 page, picture book from here. Each 2 x 2 piece would represent one page. These will be the first four pages. Open out the middle flaps again to get the next four pages.



9. Once again open out the middle flap to get the next four pages. There will now be 12 (2 x 2) pages.



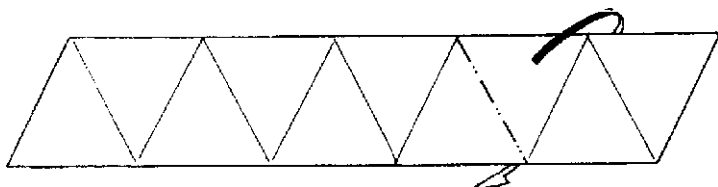
10. On opening the middle flaps of the doors you will get a cross shape and pages 13 and 14.

(Pix: Vishwas Thoke)

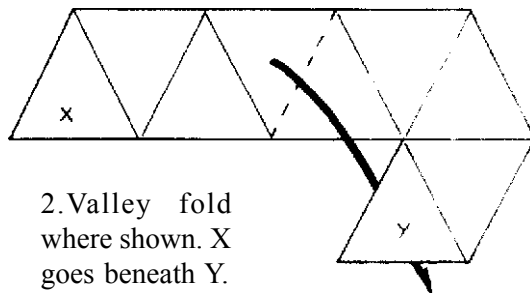


## KALEIDOSCOPE

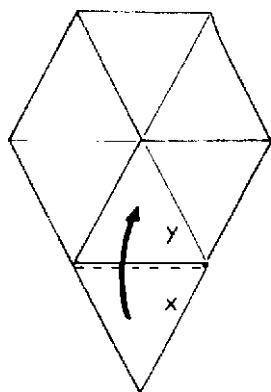
This truly fascinating model will provide you with hours of fun!



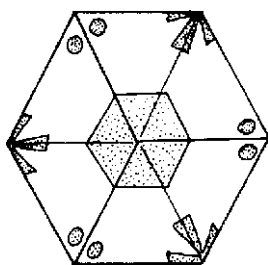
1. With a protractor, make a strip of 10 equilateral triangles; of side length 5-cm. Mountain fold the marked line.



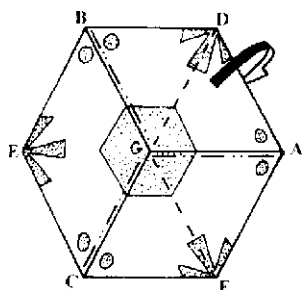
2. Valley fold where shown. X goes beneath Y.



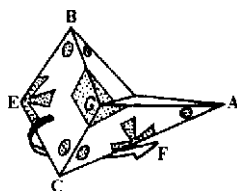
3. Glue triangle X, then valley fold it onto Y to stick them together.



4. The Kaleidoscope is now complete. Decorate as shown. Be careful to put the circles at the three corners, which have, and edge of paper leading into the center of the hexagon.



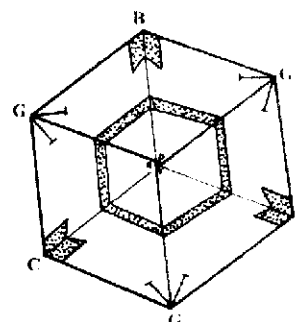
5. To change the pattern, collapse along 5 creases radiating from the centre.



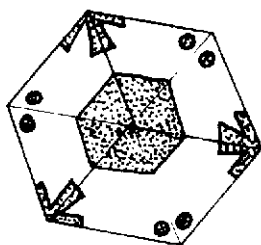
6. Fold E behind to touch F.



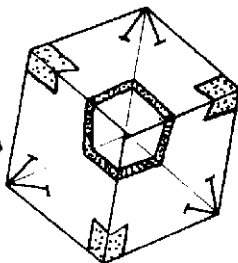
7. If you open out at the top.



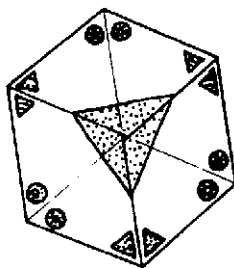
8. Then you will see a blank hexagon.



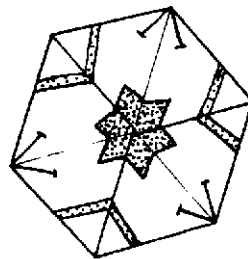
9-a



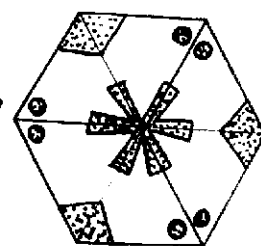
9-b



9-c



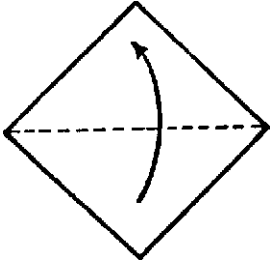
9-d



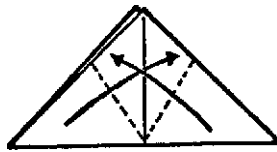
9-e

9. Decorate this step as shown in 9-b. Flex again to reveal another blank hex. Colour it as shown in 9-c. Flex again to return to 9-a. Turn over. Continue to flex and decorate. Once you learn to change the "patterns" you can make a coloured picture book of your own.

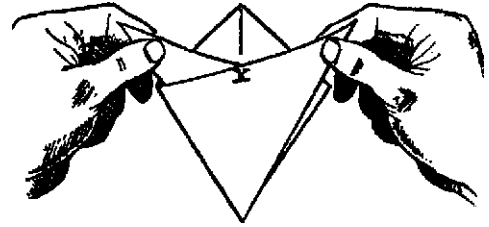
## SNOWFLAKE



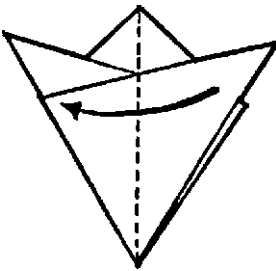
1. Take a big square from a newspaper. Fold two opposite corners to make a crease. Open up again. Fold the other two points together and leave folded.



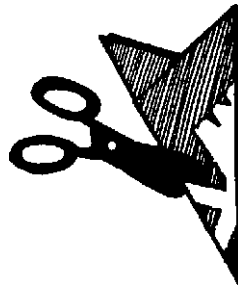
2. Making sure that the creases start from the centre of the folded edge, bring the two side points forward to lie across each other.



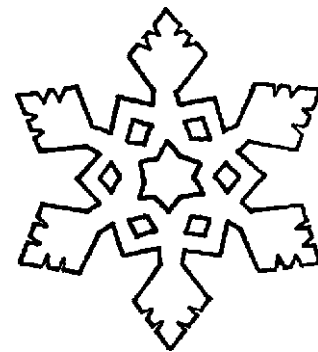
3. Carefully pull the points apart so that the angle where the edges of the two flaps meet (point X) is in line with the vertical centre crease. Now crease firmly.



4. Fold in half from right to left.



5. Make cuts through all layers, discarding the shaded area, and unfold.

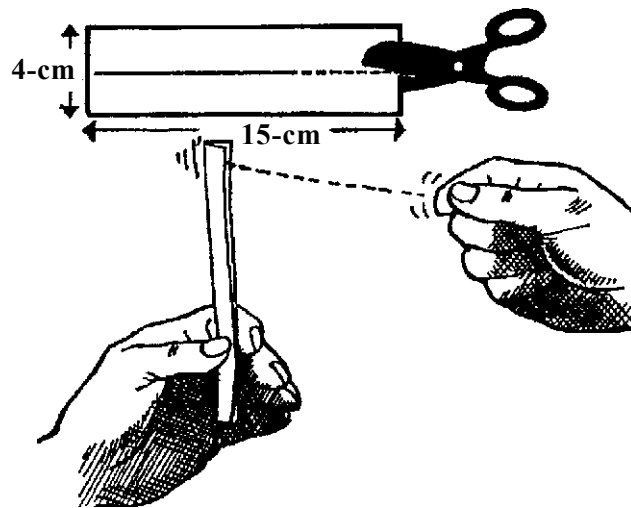


6. To find the snowflake patterns. Make variations to produce more patterns.

## INVISIBLE THREAD

1. Cut out a rectangle of paper about 4-cm x 15-cm. Cut along the centre line to about 5-cm from one end and fold the paper in half once more.

2. You can amuse a younger brother or sister by pretending to tie a thread to the paper and then acting as if you were pulling it. (In fact, you hold the paper at the cut end and secretly move it with your thumb.) By matching the movements of your free hand with those of the paper, you can almost convince onlookers that you are pulling an invisible thread.



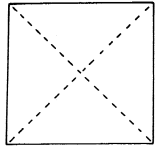
## BABLU'S BOAT - A PAPER FOLDING STORY

An amazing Origami story!

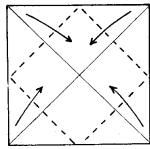
You keep folding the SALT & PEPPER BOX (*Din-Raat*) and simultaneously keep telling the story.

Bablu grew up in the city. Once he visited his grandparents in the countryside. There was a big pond near their house. Bablu wanted to sail in a boat. His grandpa gave him some money to buy a boat.

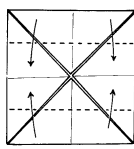
**In the meantime fold a 20-cm square from step 1 to 6.**



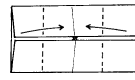
1. Take a square (20-cm side).



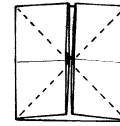
2. Fold all 4 corners to center.



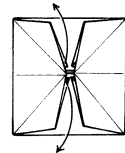
3. Fold sides to middle.



4. Again fold sides to middle.



5. Crease along marked lines.



6. Pull out the two arrow points.

Bablu went to buy a boat. While walking Bablu came to a store where they sold all kinds of interesting trinkets. "There is something I think Grandma would like to have."

"What is it?" Bablu asked the man at the counter.

"Well it is box to keep salt and pepper," replied the shopkeeper. Bablu bought it.

He hadn't gone very far before he came to another store where there were some more interesting trinkets. Bablu found a well-crafted fruit basket in this shop. He went to the shopkeeper and said.

"Will you give me this fruit basket for the salt-cellar?"

The shopkeeper was a kind man. He gave Bablu the fruit basket in exchange for the salt-cellar.

But pretty soon Bablu started having doubts about the fruit basket. "What would grandma do with this silly thing?" Soon he came across a shop selling clothes. "I'll see if I can exchange this basket for something for grandma to wear," he said to himself. He asked the man in the store:

"Why yes, I'll give one of those jackets and some money too, because the fruit basket is worth more than this." And then he held up the jacket.

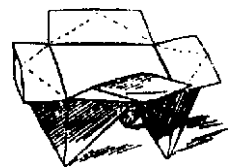
And now that Bablu had something for his grandma he felt he ought to get something for his grandpa. Because he had bought a jacket for his grandma, he thought of buying a pair of trousers for grandpa.

By now Bablu had almost forgotten the purpose of his visit. He suddenly saw the sign: **'BOATS FOR SALE'**.

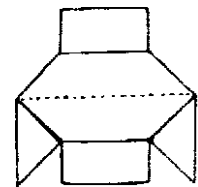
"That's the place I'm looking for," he said and went in. When Bablu told the man what he wanted the man said, "Yes, we have boats for sale, come out in the yard and see them." But then Bablu found that they were motorboats, each with two funnels, and he had to say, "I don't want a motor-boat, I want a boat which, I can row."

"All right, said the man, down the street a little way you'll find another place, which might have a row boat." So along the street Bablu went.

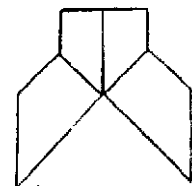
He began to think maybe his grandma and grandpa would like to buy their own clothes, and just then he found himself in front of a furniture store. He spotted a pretty table in the store. He liked it instantly. So he went in and said to the man, "Would you give me that table for this trousers and jacket?" "Why, yes;" the kind man said, "I'd be glad to." So Bablu carried the table and started to walk.



**SALT CELLAR  
FRUIT BASKET**



**JACKET**



**TROUSERS**



**TABLE**

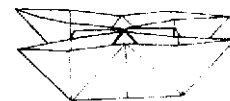
By this time he had walked a good deal and felt very thirsty. He began to wonder where to get water to drink. Suddenly, he spied a windmill. He knew there would be water where there was a windmill and so he went over and got a drink of water.

WINDMILL



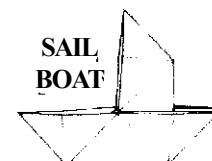
And now at last he saw that sign **BOATS FOR SALE**, so he went into the store. "I am looking for a rowboat," Bablu said. "Well," the man said, "I have some rowboats, but they are all twin boats."

"What in the world could I do with boats like that," Bablu said and walked out. "Well," the man said, "go down to the next corner, and turn to the right: you'll see a place where they sell boats. Maybe that man has rowboats."



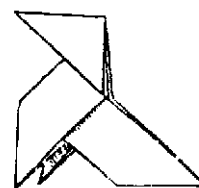
TWIN BOATS

So along Bablu went, carrying the table. He came to the store and asked the man if he had boats for sale, the man said, "Why yes, we've got boats for sale. Take a look at them."



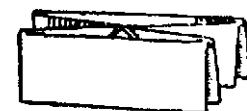
SAIL  
BOAT

But when Bablu saw them he said, "Why they are all sailboats, whereas I want a rowboat." So he could buy none there.



ROOSTER

All this while Bablu had been lugging the table on his shoulder. Suddenly, it began to feel very heavy and he began to wonder, why he bought it in the first place. "Grandma has plenty of furniture," he said. Just then he came out and saw a chicken scurrying in an open field. "There," he said, "we haven't a single chicken in our place. Couldn't I trade this table for one." He spoke to the farmer and the farmer said, "Why yes, how would you like to give me your table for this rooster." That is what Bablu wanted. So he gave the farmer the table and put the rooster under his arm and started on.



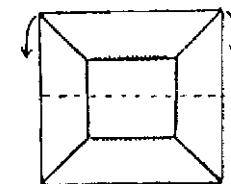
POCKET BOOK

He'd gone a good way by this time. He realized that he still hadn't bought the boat. The thought made him uncomfortable. By now he did not have enough money to buy a rowboat. While he was wondering what he should do a sudden gale of wind blew his hat off, and when he raised his hand to catch it, the rooster got away! There, he had spent a fortune and the rooster flew away and so did his hat! And so he walked along thinking very hard, looking down at the ground. All of a sudden he spied something and stooped over and grabbed it. It was a pocket book with some money in this side and some in this. By this time he was pretty well out of the village. There was not a soul in sight. So he said to himself. "Well, now I'll use this money to buy a boat."



CAP

"But first, I must get a hat. I can't go home this way," he said to himself. So he found a store and bought this cap.

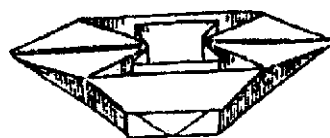


PICTURE FRAME

Then he thought, "I really ought to take something home for grandma." The only thing that didn't cost too much was this picture frame. He thought it would be nice for grandma to put his mother's picture in the frame.

By this time the day was nearly gone and he said, "I'll buy any kind of boat now, I don't care what it's like. The next place I find where they sell boats, I'll buy one of them." So he kept looking for a sign, until after a little while he saw one, **BOATS FOR SALE**. In he went and asked the man, "Can you sell me a boat?" "Yes," the man said, "but I've got the queerest looking boats you ever saw."

Never mind," Bablu said, "I've been looking for a boat for such a long time, I'll take any kind of boat." "Here they are," the man said and when Bablu asked him what they were he said, "We call them Chinese junks." So after all the trouble, Bablu got a boat at last and went home happy.



CHINESE JUNK  
(INTERIM)



CHINESE JUNK

## THINKING OUTSIDE THE BOX!

Some ‘tricks’ or puzzles can be used to help children realise the importance of looking at things in new ways – of going beyond the limits their own minds have set. Here is an example.

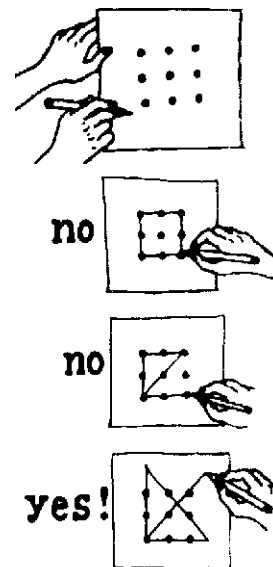
Draw 9 dots on a paper, on the blackboard, or in the dust, like this. Ask everyone to try to figure out a way to connect all the dots with 4 straight lines joined together (drawn without lifting the pencil from the paper).

You will find that most persons will try to draw lines that do not go outside the imaginary square or ‘box’ formed by the dots.

Some may even conclude that it is impossible to join all the dots with 4 lines.

You can give them a clue by saying that, to solve the puzzle, they must go beyond the limits they set for themselves.

At last someone will probably figure out how to do it. The lines must extend beyond the ‘box’ formed by the dots.



Teachers will be able to help children *learn by doing* if they, themselves *learn by doing*.

To set a good example, teachers need to:

Treat children as their equal – and as friends.

Respect their ideas and build on their experiences.

Invite co-operation; encourage those who are left behind.

Make it clear that we do not have all the answers.

Welcome criticism, questioning, initiative, and trust.

Always be on the side of the children.

These ideas are beautifully expressed in this old Chinese verse:

*Go in search of your people  
Love them  
Learn from them  
Serve them  
Begin from what they have  
Build on what they know.*



*But of the best leaders  
When their task is  
accomplished,  
Their work is done  
The people all remark  
“We have done it ourselves!”*

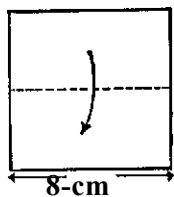


**In what ways do our  
schools help this child  
to meet his needs?**

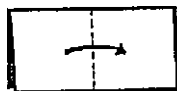


## FLYING CROSS

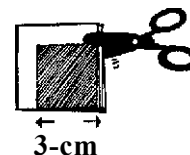
You will need a piece of stiff card sheet, pencil and ruler and scissors for making this model.



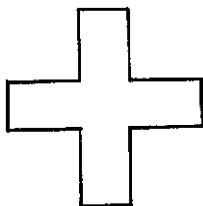
1. Cut a 8-cm square from a card sheet. Fold its top edge to the bottom.



2. Fold the left edge to the right.

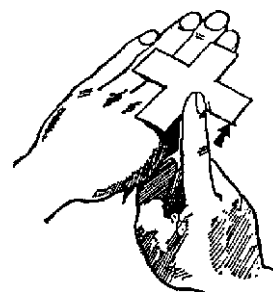


3. Measure 1-cm in from the left hand and down from the top. Draw these lines. Cut along the lines through all four layers and remove the shaded area.



4. Unfold the paper and you will have a cross. Smooth out the creases.

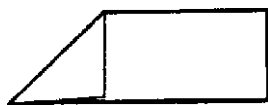
5. Place the cross on the back of your left hand so that one of its arms lies along your forefinger. Keeping your left thumb tucked out of the way, strike the edge of the arm which sticks out with your right forefinger. The cross will spin away and back again like a boomerang.



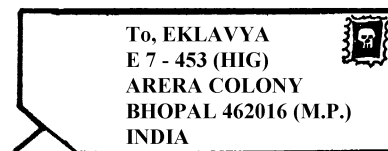
## SELF-OPENING ENVELOPE

This is a very clever way of opening a letter.

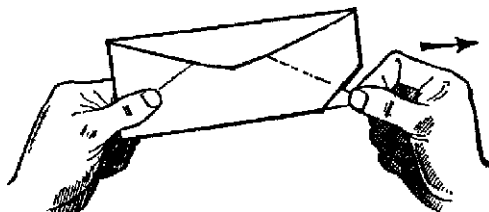
First write a letter and address an envelope in the usual way. Then fold the letter to fit the envelope.



1. Fold the letter so that one end lies along the bottom edge.



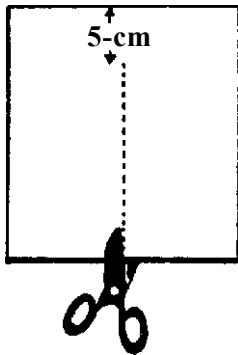
2. Cut off one corner of the envelope. Place the folded letter inside with the pointed end sticking through the hole in the envelope. Seal and post.



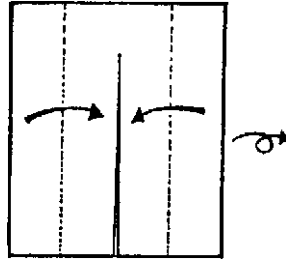
3. To open, just take hold of the point and pull sharply. The letter will slice through the envelope like a knife.

## INSECT RACE

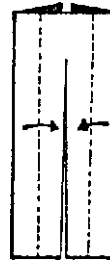
You will need one sheet of paper. One 4-cm square coloured paper, pencil, ruler and scissors.



1. For the track fold the two longer edges of the sheet of paper together, crease and open up. Cut this crease line up to about 5-cm from the top.



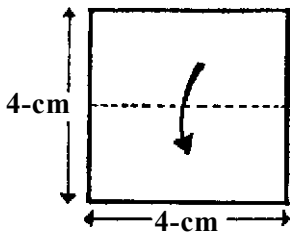
2. Fold the two sides to the centre line. Crease firmly and turn over.



3. Turn over. Bring the two folded edges to the centre line and crease firmly.



4. Draw a horizontal line about 5-cm from the top (where the cut ends). This completes the track.



5. To make the insect: fold opposite sides of the little paper square together in turn and leave folded in half.



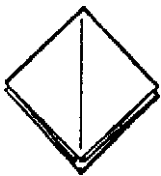
6. Make sure the folded edge is at the top; then fold the top right corner to centre bottom. Turn over.



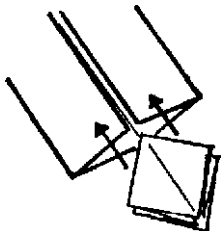
7. Fold the top right corner to centre bottom.



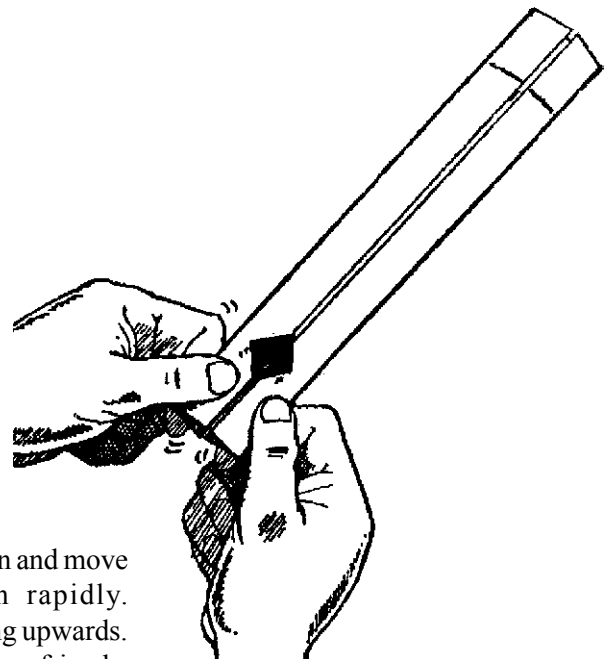
8. Now pull the middle layers apart, opening out the centre. Allow the two sides to flatten out and the corners to come together in the centre.



9. This completes the insect.



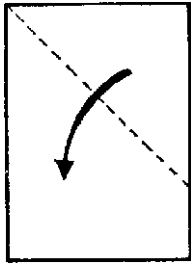
10. Slide the insect into the track - with its triangular flaps in the track.



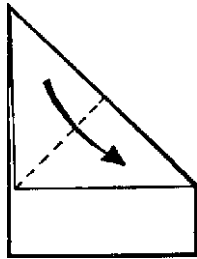
11. Now hold the track as shown and move each hand back and forth rapidly. You will find the insect climbing upwards. Organize an insect race with your friends.

## ORIGAMI PLANE

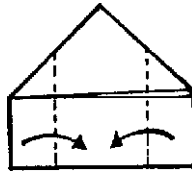
For making this delightful plane you will need a sheet of bond paper.  
First fold the two longer edges together, crease and open out. This is to make the vertical centre line.



1. Fold the top edge to lie along the left edge.



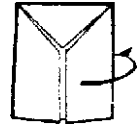
2. Fold the left edge to lie along the horizontal edge.



3. Fold the two sides to the centre.



4. Fold the top point down.



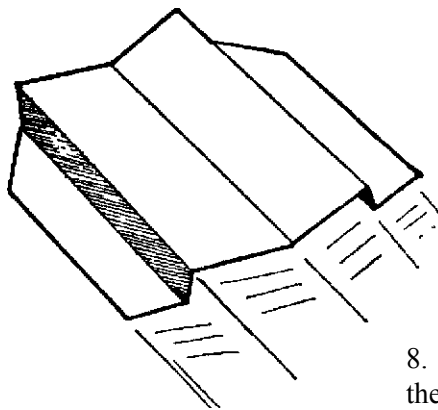
5. Fold in half behind.



6. Fold the top flap to the left. Fold the rear flap in the same way...



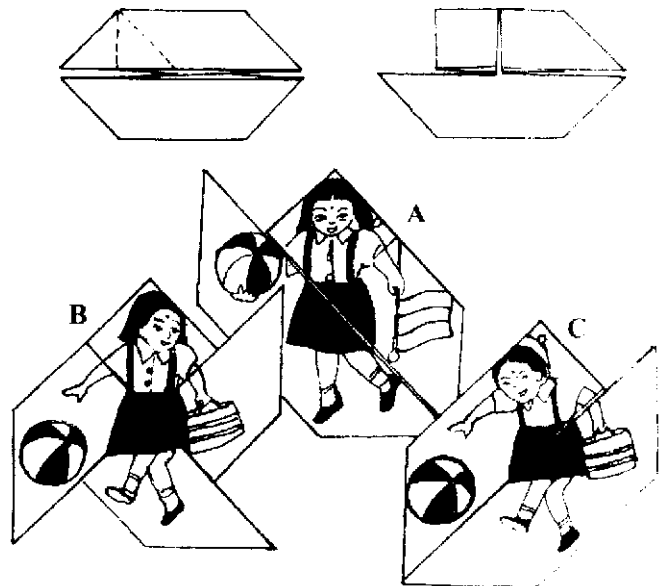
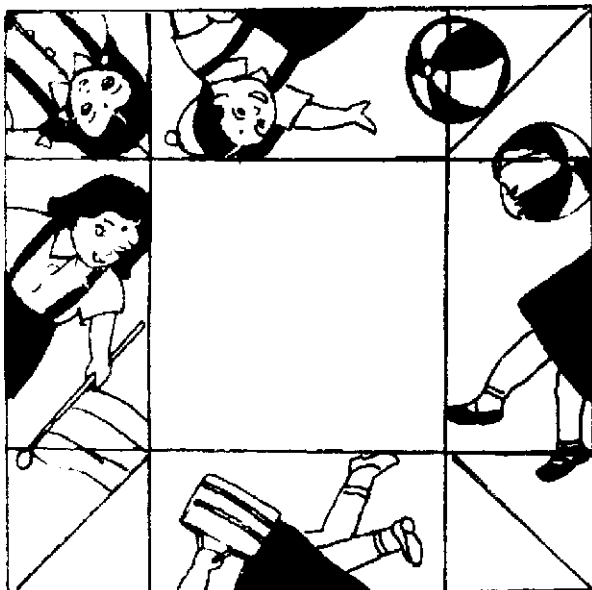
7.... like this. Open out.



8. Launch the plane into the air and watch it fly.

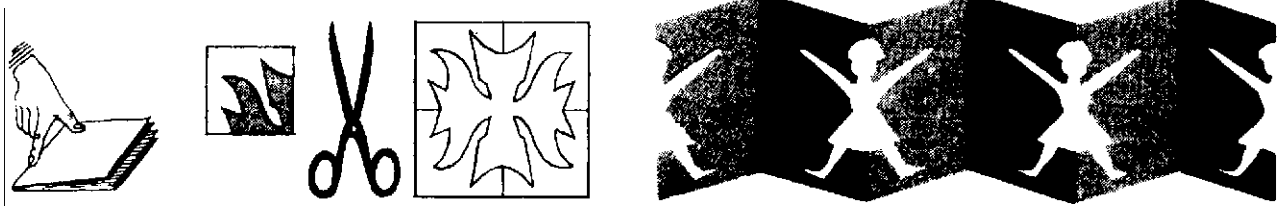
## PICTURE MAGIC

Take a 15-cm square of white paper and copy the picture shown in the diagram. Fold it like a double boat - see *Bablu's Boat* (page 32). When you lift up one corner of the model and squash, you will see the picture in A. By opening and closing the flaps of the folded model you will see pictures B and C.



(ORIGAMI Volume II - Indu Tilak)

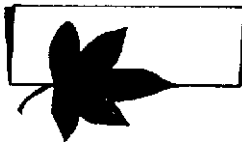
## PAPER-FOLDING AND CUTTING



Fold twice and cut out shape:

Make multiple fan-folds in a paper and then cut out half a figure.

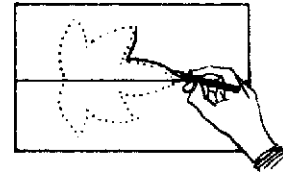
## PAPER FOLDING AND PRICKING



Take a leaf and place it on a folded piece of paper:

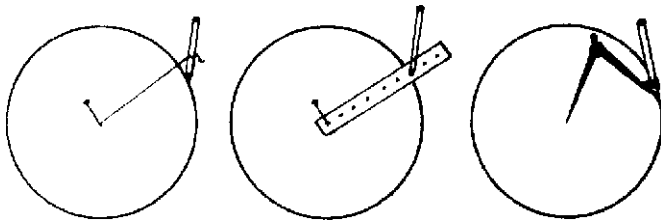


With a pin prick round the half shape:



Draw round the pin marks and you will have a shape that balances.

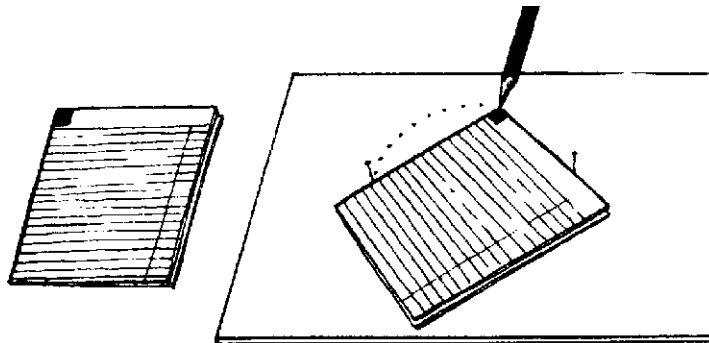
## DRAWING CIRCLES



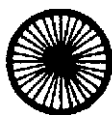
These are the regular ways of drawing a circle.

But here is an unusual way.

Take a rectangular piece of paper. Place two pins on a piece of board about 4-cm apart. Move the right angle between the two pins so that the sides of the paper touch them. Mark a dot at the right angle and move the position several times. When you have completed the semi-circle point the right angle the other way and complete the circle.



clock



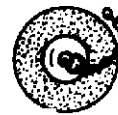
wheel



eye



potter's  
wheel



bath plug

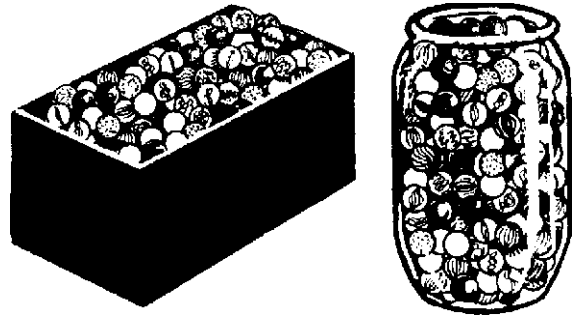


fried egg

**CIRCLES ARE IMPORTANT AND WE FIND THEM EVERYWHERE**

## CLOSE PACKING

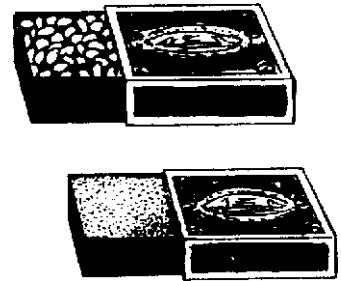
Make a collection of containers and investigate the amount each holds. How many marbles can be packed into an empty jam bottle? First make a guess. Then test your estimate by actually filling the bottle with marbles. Do the same thing with a rectangular chalk box. Try filling a number of matchboxes with different objects.



## TINY THINGS

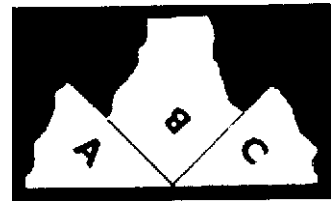
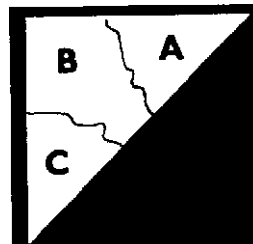


How many different things (one specimen of each) can you fill in a standard matchbox? For doing this you will have to start looking for the tiniest things around you. One school girl was able to pack more than 250 different specimens in a single matchbox! (Start collecting things like hair, mustard seed etc.)

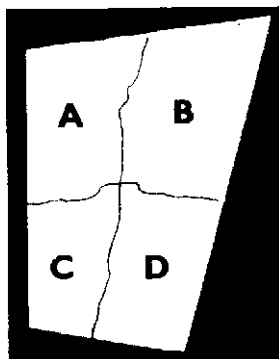


## ANGLES OF A TRIANGLE

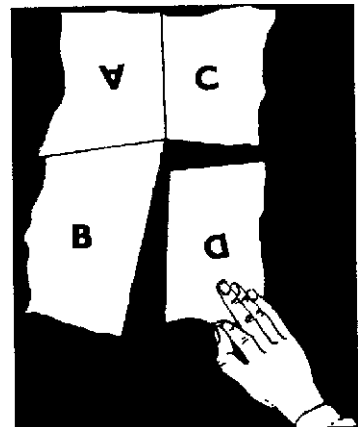
Tear the triangle into three parts and then bring the three angles together to make 180 degrees. Try this with different triangles.



## ANGLES OF A QUADRILATERAL

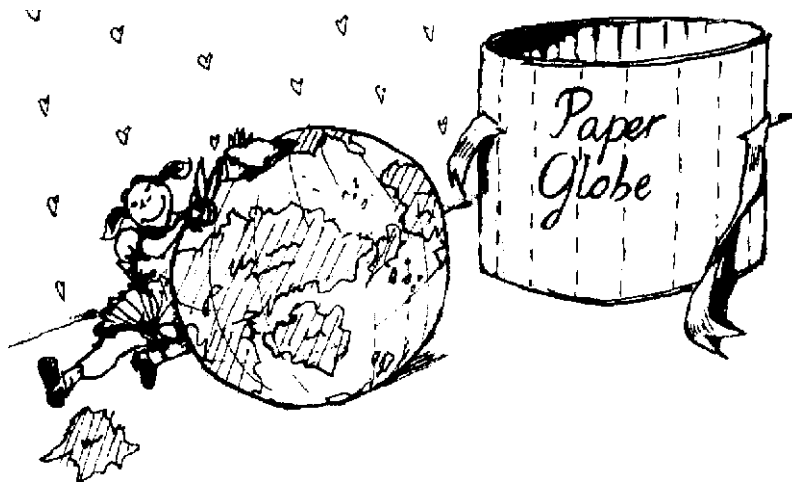


Take any four-sided quadrilateral. Tear it as shown into four parts. Then bring the four-corners of the quadrilateral together. They will snug into each other to add up to 360 degrees. Try this exercise with different shapes of quadrilaterals.





## SURFACE AREA OF A SPHERE



An impulsive little girl who had just been given a paper globe found nothing better to do with it than to cut it into thousands of tiny pieces. Since she still had the cylindrical container (like a tube) that it came in, she decided to unroll the box and glue the pieces inside. The box was originally big enough for the whole globe, so she assumed that there would be plenty of space.

She was astonished to discover that she needed to use the entire surface to glue all the pieces of the globe. Her impulsiveness did not prevent her from having a flair for geometry, so she realised that the surface area of the cylindrical box must be equal to the surface area of the enclosed sphere.

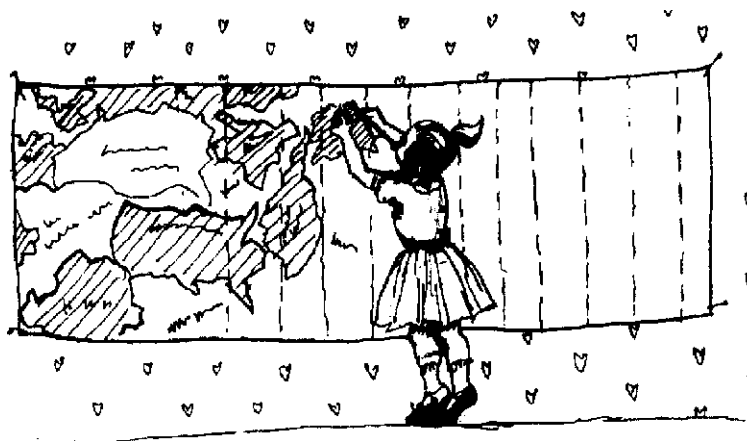
Since the height of the cylinder is twice the radius  $R$  of the sphere.

The circumference of the base of the cylinder will be  $2 \times 3.14159 (\pi) \times R$

The area of the cylinder will be  $A = 2 \times R \times (\pi) \times R$  or  $A = 4 \times 3.14159 \times R \times R = 4 (\pi) R^2$

Reflecting on her discovery, she concluded that since the radius of the earth is about 6400 kilometres, its surface area must be approximately

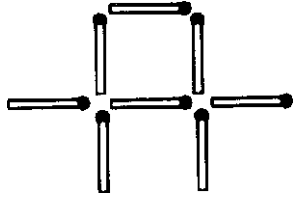
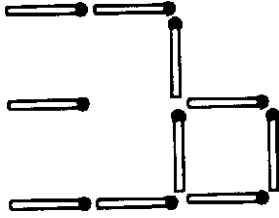

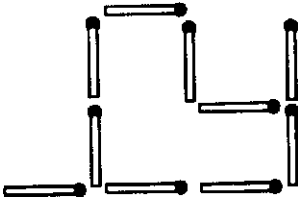
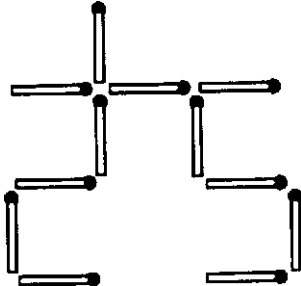
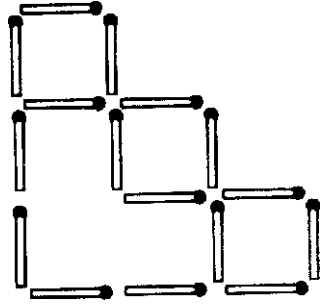
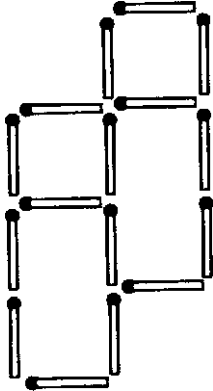
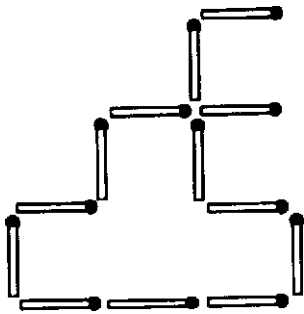
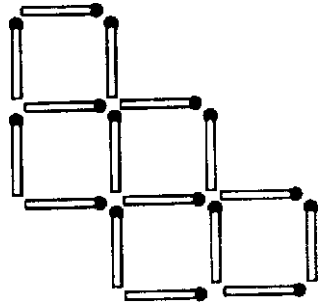
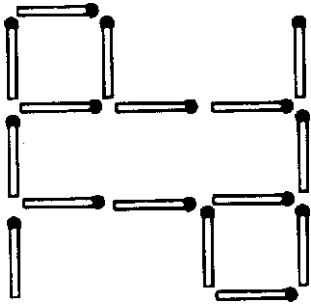
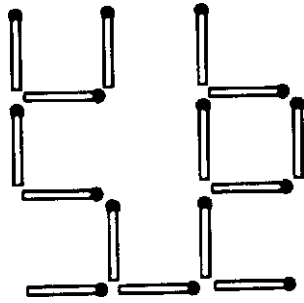
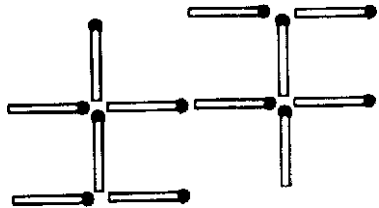
$A = 4 \times 3.14159 \times (6400) \times (6400) \text{ km}^2 = 515 \text{ million square kilometres.}$



(Pix: THE MOST BEAUTIFUL MATHEMATICAL FORMULAS, Salem)

## MATCHSTICK MATCHING

Move only as many matches as directed and create as many squares as requested.  
(Squares can overlap or have corners in common.)

	CHANGE 2 STICKS	CHANGE 3 STICKS	CHANGE 4 STICKS
MAKE 2 SQUARES			
MAKE 3 SQUARES			
MAKE 4 SQUARES			
MAKE 5 SQUARES			

## WHERE WE COMPETED WITH OURSELVES



My school in Japan was a British School called St. Michael's International School. It was in Kobe. When I went to Japan I had passed Standard III from St. Anthony's High School in New Delhi, so I was admitted to Standard IV and was in that school for three years.

This year I finished my schooling and now I am in a college! When I look back at the eight different schools I attended, I realise that St. Michael's has made me what I am today. My teachers there taught me to enjoy studies, to do original thinking, to love myself and to love the world.

In Standard IV my teacher was Mr. Shand. He taught us everything except music, physical training, Japanese and a subject called as reading skills. There was no fixed curriculum or textbooks, which had to be covered. At least Mr. Shand seemed to have all the freedom to decide how best he would develop his students to pull them up to the level of mental growth expected of a particular age group.

In history we chose topics of our interest from the ones Mr. Shand gave. Mr. Shand told us to collect all the information on the topics of our choice by referring to the books in the library, which were selected after consultation with the librarian. We worked either individually or in twos. Geography was taught partly in the same way, and partly in outdoor lessons when he took us out for walks in the mountain and showed us how rivers and lakes were formed, how plantation was done to stop the erosion of soil and so on. In the same way, from the top of the mountain he explained to us why population is dense on the plains, and why industries grow around the port. We had no tests, no homework exercises, no examinations, and yet we thought we had learnt geography very well.

For English we not only read books recommended by the teacher but also the books we thought we should enjoy. In the class we wrote our own stories and poems. The teacher would sometimes give us a topic, sometimes he gave us a line or sometimes he showed us a picture on which to write the story. Mathematics constituted of sets of cards of different levels. We were required to work through them at our own speed and capacity. So at any given time in a class, there would be students doing Math of the level of a class below or two classes above.

Science consisted of studying slides ranging from cells to the moon. Everything we were taught was supported by practical examples. For example, in Standard V we were to study parts of the human body. We were given two plastic models - actually we were given parts - one male and one female. We had to identify each part, paint it and fit it in its place to construct the model. In science too, the emphasis was on understanding and not on reproducing. We did not have to write answers to questions. While studying blood cells, we were asked to prick our own fingers and make slides, which we observed. And all this we did in standard IV!

Music lessons were great fun! Our teachers taught us all kinds of songs and moreover taught us how to play them on a recorder. We would also play musical Bingo where prizes, would be rubbers and chocolates, the aim would be to teach us various kinds of musical instruments and musical notes. We had lessons in folk dancing, which we thoroughly enjoyed. But what we enjoyed most was the play-acting. Our teachers told us to select a story, write a short play on it, form groups, distribute the roles and enact it. Everyday our first period was used this way and we all thought it was the best possible start for the day at school.

In one term Mr. Shand hit upon a novel idea! He announced in the class that we were going to make a film during the term and the film included all our studies! So he suggested a few themes for the story. We selected 'The Time Machine'. We invented a suitable story making the time machine run into the remote past and also the remote future.

We wrote the dialogues. We made costumes. We made the time machine. Mr. Shand taught us about the make-belief world of films and so we decorated our time machines with all sorts of things like springs, wheels, tapes and what not! We had outdoor shooting in a forest and we wore strange costumes as barbarians! It took us two and a half months to complete the film and we thought we had learnt a lot during those days, much more than what we would have learnt from textbooks. In Christmas parents were invited to see this ‘great’ film made by Standard IV pupils and the parents were so proud of their little ones who had turned into stars!

We had library period once a week. It was not just for returning and borrowing books, but we were also shown how the library works - how books are registered, how they are arranged on shelves and so on. Two students were actually made to sit next to the librarian and they stamped the books given out and put back the books returned.

Once Mr. Shand asked us in the class what we wanted to do in life and I was the only one who said, “I want to be a writer”. Mr. Shand liked that idea. He said, “Why not start from today? Write a storybook for our K.G. classes. Draw some pictures. Make it a neat manuscript. And then I will ask the K.G. teacher to read it out to the students. We will go and see how they like it!” I was so thrilled! I remember at least five of my books were read this way, and the little children told me, “Radhika! It’s a beautiful story. I liked it!” But Mr. Shand did not stop there. He said to me, “Radhika, when you will become a great writer, you will need to know typing. I am arranging typing lessons for you everyday in the recess. Let’s go to the office and fix it”. So for two years I learnt typing from the age of nine!

Mr. Jackson, who was my teacher in Standard V, has etched a permanent corner in my heart for himself. He was 40 years old and a confirmed bachelor. He hated competition and wanted each child to think highly of itself. In Standard V there was a girl who was still doing Standard IV Math, but when we did our respective sums correctly we all got ‘excellent’ in our notebooks.

Once he said to my mother, “If at all you must compete, you must compete with your own self. Try to improve yourself day after day. That is the message of Hinduism, isn’t it? In every life your soul becomes purer till it attains freedom. What a wonderful idea!”

I don’t remember the exact wording of the motto of St. Michael’s but its meaning was, ‘A child should never feel that it is treated unfairly’ and every teacher strove to live up to it. We were free to argue with our teachers. They always wanted to understand why we were doing a particular thing. Not one teacher was authoritative, nothing was forced on us.

*(Radhika Aradhya)*

#### Solutions to Cryptograms

1. S = 1, O = 7, I = 3, L = 4, B = 6, Y = 2.
2. S = 3, L = 0, Y = 6, R = 5, I = 9, G = 1.
3. C = 1, R = 4, A = 9, B = 5, S = 0.
4. M = 4, E = 6, A = 2, L = 1, S = 5.
5. T = 9, E = 0, P = 1, I = 5, L = 7.
6. P = 8, E = 1, N = 3, R = 6.
7. D = 8, O = 4, G = 9, F = 1, A = 0, N = 2, S = 7.
8. H = 9, O = 3, T = 2.
9. L = 6, U = 7, S = 1, H = 9, E = 0, R = 5.
10. S = 5, P = 9, I = 4, T = 6.
11. T = 2, A = 5, P = 8, E = 6.
12. S = 9, E = 5, N = 6, D = 7, M = 1, O = 0, R = 8, Y = 2.
13. W = 0, I = 6, N = 2, L = 5, A = 7, S = 8, T = 9.
14. A = 4, H = 6, O = 2, G = 5, T = 1, I = 0, E = 7.
15. O = 6, N = 9, E = 3, R = 8, Z = 1.
16. T = 7, H = 5, I = 3, S = 0, V = 1, E = 9, R = 4, Y = 2, A = 5.
17. C = 9, R = 6, O = 2, S = 3, A = 5, D = 1, N = 8, G = 7, E = 4.
18. M = 1, E = 3, T = 7, R = 4, L = 6, I = 9, G = 5, A = 7, S = 2, C = 8.
19. J = 8, U = 4, N = 3, E = 2, L = 7, Y = 5, A = 1, P = 6, R = 9, I = 0.

#### 20. FIND OUT FOR YOURSELF!

## CRYPTOGRAMS

Here are some tough puzzles.

These are sums with a difference, and the difference is obvious: instead of numbers you've got letters!

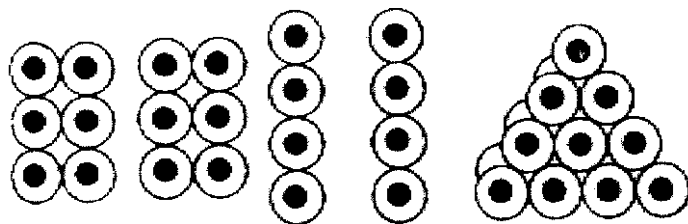
Each letter for one of the ten digits from 0 to 9, and a particular letter can stand for only one digit.

The challenge is to find out what each letter stands for, and do the sums!

(It is a big challenge, so don't be surprised if you have to look up the answers)

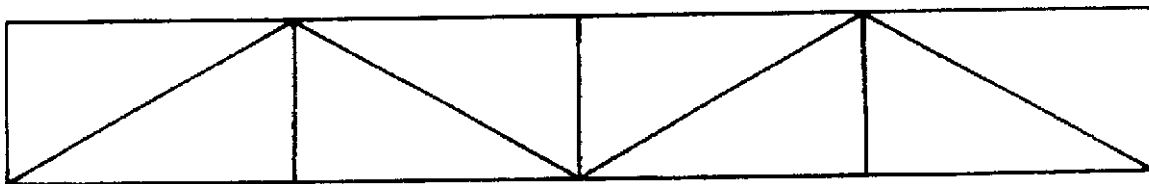
1.  $\begin{array}{r} \text{BOYS} \\ + \text{BOYS} \\ \hline \text{SILLY} \end{array}$	2.  $\begin{array}{r} \text{GIRLS} \\ + \text{GIRLS} \\ \hline \text{SILLY} \end{array}$	3.  $\begin{array}{r} \text{ARCS} \\ + \text{BRAS} \\ \hline \text{CRASS} \end{array}$	4.  $\begin{array}{r} \text{LLAMA} \\ - \text{SEAL} \\ \hline \text{SEAL} \end{array}$
5.  $\begin{array}{r} \text{LIP} \\ + \text{LIT} \\ \hline \text{PIPE} \end{array}$	6.  $\begin{array}{r} \text{PEP} \\ + \text{PEN} \\ \hline \text{ERNE} \end{array}$	7.  $\begin{array}{r} \text{GOOD} \\ + \text{DOG} \\ \hline \text{FANGS} \end{array}$	8.  $\begin{array}{r} \text{TOO} \\ \text{TOO} \\ \text{TOO} \\ + \text{TOO} \\ \hline \text{HOT} \end{array}$
9.  $\begin{array}{r} \text{HER} \\ + \text{HURL} \\ \hline \text{SEL LS} \end{array}$	10.  $\begin{array}{r} \text{SPIT} \\ + \text{SIP} \\ \hline \text{TIPS} \end{array}$	11.  $\begin{array}{r} \text{PET} \\ \text{PET} \\ + \text{PET} \\ \hline \text{TAPE} \end{array}$	12.  $\begin{array}{r} \text{SEND} \\ + \text{MORE} \\ \hline \text{MONEY} \end{array}$
13.  $\begin{array}{r} \text{STILL} \\ \text{STALL} \\ + \text{STILT} \\ \hline \text{NITWIT} \end{array}$	14.  $\begin{array}{r} \text{EIGHT} \\ + \text{EIGHT} \\ \hline \text{TATTOO} \end{array}$	15.  $\begin{array}{r} \text{ONE} \\ + \text{ONE} \\ \hline \text{ZERO} \end{array}$	16.  $\begin{array}{r} \text{THIS} \\ \text{IS} \\ + \text{VERY} \\ \hline \text{EASY} \end{array}$
17.  $\begin{array}{r} \text{CROSS} \\ + \text{ROADS} \\ \hline \text{DANGER} \end{array}$	18.  $\begin{array}{r} \text{METRE} \\ \text{LITRE} \\ + \text{GRAMS} \\ \hline \text{METRIC} \end{array}$	19.  $\begin{array}{r} \text{JUNE} \\ + \text{JULY} \\ \hline \text{APRIL} \end{array}$	20.  $\begin{array}{r} \text{THREE} \\ \text{THREE} \\ + \text{FOUR} \\ \hline \text{ELEVEN} \end{array}$

### TETRAHEDRON PUZZLE



A lovely puzzle can be made from 20 plastic balls. Glue the spheres together to form two rectangular blocks each containing six spheres, and two strings of four spheres as shown. The puzzle is to fit the four sphere structures together to form a tetrahedron. It may seem difficult at first, but it is certainly possible!

### SIMPLE PAPER TETRAHEDRON

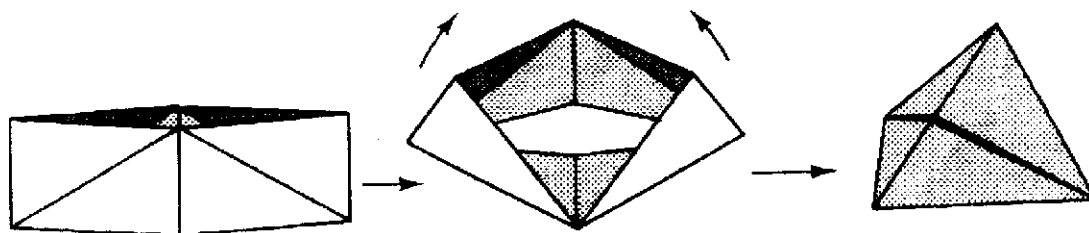


This is a simple tetrahedron and it will fold instantly. For this you will need a card sheet 28-cm long and 4-cm wide. Divide the long rectangle into four small equal rectangles (7-cm long and 4-cm wide). Mark the diagonals as shown.

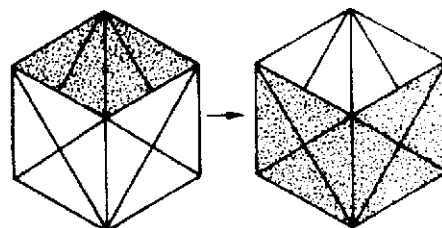
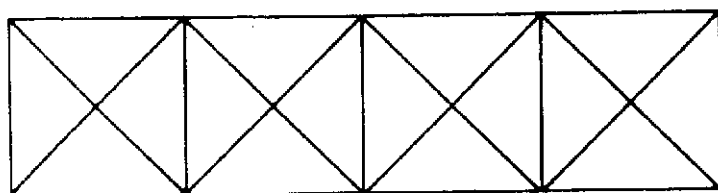
Carefully score all the vertical and diagonal lines using an old ball pen refill.

Now join the ends of the long rectangle together using sticky tape to form a circular hoop.

This band can now be easily folded into a tetrahedron.



### INSIDE OUTSIDE FLEXIBLE BOX



This flexagon is simple to make. Cut out a rectangle from a thin card equivalent to four squares (20-cm x 5-cm is a good size) and draw the diagonals of the squares. Carefully score all the lines and flex the rectangle along each of them to ensure ease of movement. Colour the two sides of the rectangle differently. Join the ends to form an open and bottomless box.

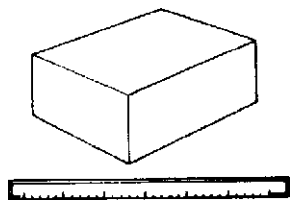
Now, by folding the edges and diagonals of the squares it is possible to turn the box inside-out.

While doing it you will encounter several interesting configurations including a box approximately half the height of the original.

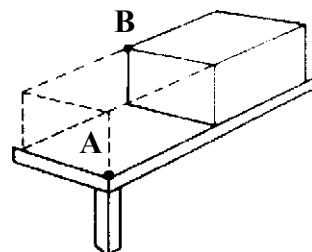
Don't give up if you don't succeed at first. Keep trying!



## DIAGONAL OF A BRICK



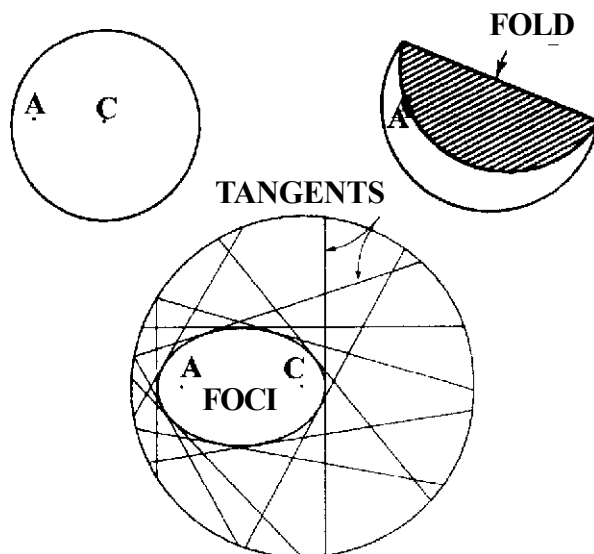
How can you use a ruler to find the length of the long diagonal – from one corner of the brick to its opposite corner? The solution is surprisingly simple. First place the brick at the corner of the table and then move it along equal to its length. The length of the diagonal from  $A$  to  $B$  can then be easily measured.



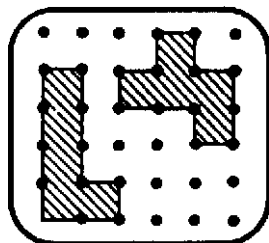
## FOLDING AN ELLIPSE

On a plain paper draw a large circle of 16-20 cm diameter.  $C$  is the centre. Cut the circle and mark a point  $A$  as shown, say 2-cm from the edge. Now fold the circle along any line that makes the circle just touch the point  $A$ . Keep repeating this process of folding. Soon you will see an ellipse - surrounded by all the fold lines. What would happen if  $A$  were nearer the centre of the circle?

What happens if  $A$  coincides with the centre? Notice the way in which  $A$  and the centre of the circle  $C$  are symmetrically placed for the ellipse. They are called the foci of the ellipse.



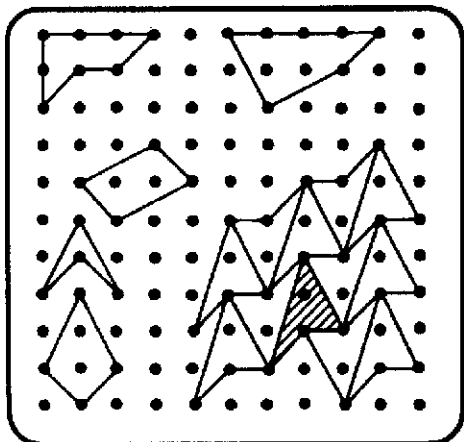
## PERIMETER AND AREA



Make as many shapes on the pin-board as possible with a perimeter of 12 units. Record your shapes on a square copy.

The two examples given have an area of 5 units each. Find the area of each of your shapes?

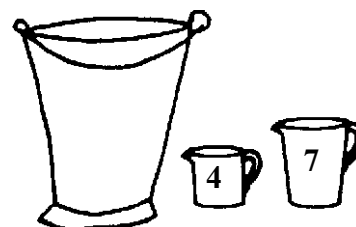
## TESSELATIONS



The shaded quadrilateral is repeated over and over again to form a tiling pattern. Some other shapes have been given. Make tiling patterns with them. Try experimenting with some new shapes.

## MEASURING OUT

You have two measures of 4-liters and 7-liters and a bucketful of milk. How will you give 2-liters of milk to a customer?

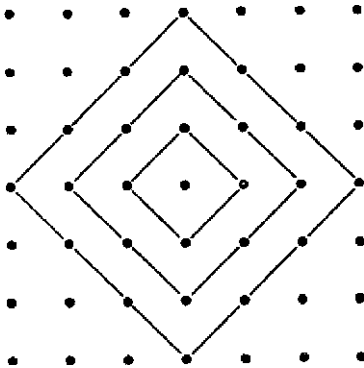


## NUMBER PATTERNS WITH DOTS

Make a pattern and count:

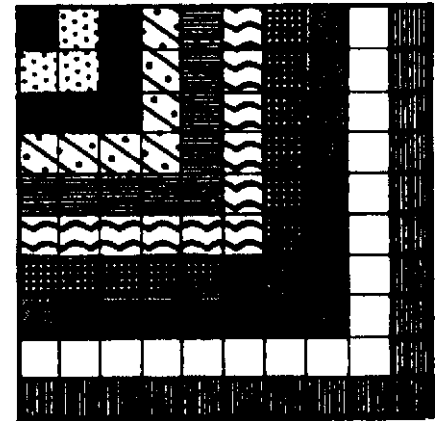
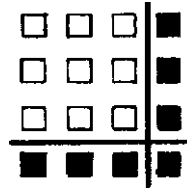
a. The number of dots on the perimeter of each square: 4, 8, 12...

b. The number of dots inside each square: 1, 5, 13...

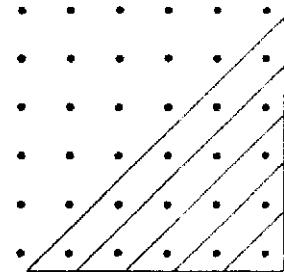


**Another pattern for Square Numbers**

This diagram might help you to discover an easy way of finding the next square number.



Triangular numbers are formed by making a sequence of right-angled triangles as shown and counting the number of dots in each triangle.

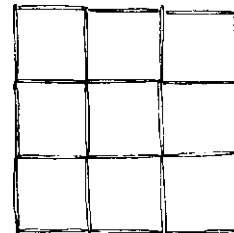


1 3 6 10 ...

How many dots would there be in the twelfth triangle?

## FUN WITH BROOMSTICKS

Get 24 same size broomsticks and arrange them as shown. How many squares do the toothpicks make? (Certainly not 9!) Remove only 8 toothpicks so that only 2 squares are left. Is it possible?



What's the least number of broomsticks required to make a square? Four!



What about 2 squares? Seven. (That's wonderful!)



Three squares?

Can you find a pattern?

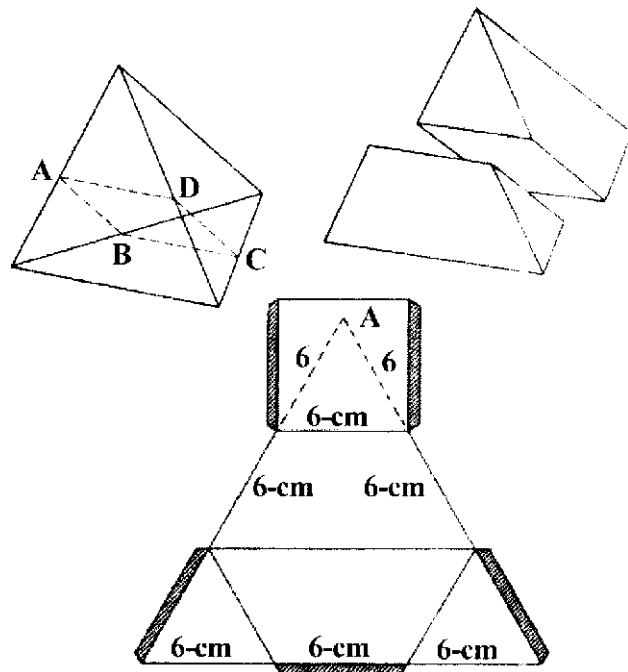
Use 12 broomsticks. Place them any way you wish.

How many different numbers of squares can you make?

BROOMSTICKS	SQUARES
4	1
7	2
?	3
?	4

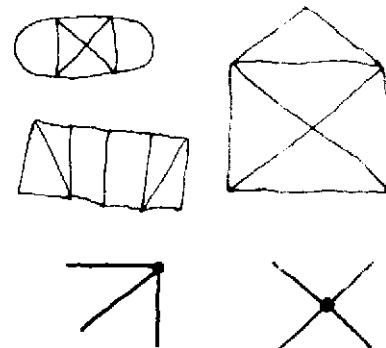
## TWO-PIECE TETRAHEDRON

In the picture shown the tetrahedron has been sliced into two equal parts. The points **A**, **B**, **C**, and **D** are the middle points of each edge. To make the half tetrahedron you will need some card. Make an equilateral triangle **ABC** whose each side is 18-cm. By marking off points at intervals of 6-cm most of the net can be easily constructed. Now only the square remains to be added to the top. Before cutting out mark the tabs (shown shaded) and score all the folds with an old ball pen refill. Make two such nets. Cut them, fold and glue them to form two exactly similar shapes.



## DRAWING WITHOUT LIFTING THE PENCIL

Can you draw this shape without lifting your pencil from the paper? And without retracing any line? When you have figured it out, ask a friend to draw it on the ground. You can actually predict by just looking at a shape whether it can be drawn without lifting the chalk or retracing a line. The points where the lines meet are called vertices. Depending upon the number of lines meeting at the point it could be an odd or an even vertex. Just count the odd vertices in any shape. Does it give you a clue?



**ODD  
VERTICES**

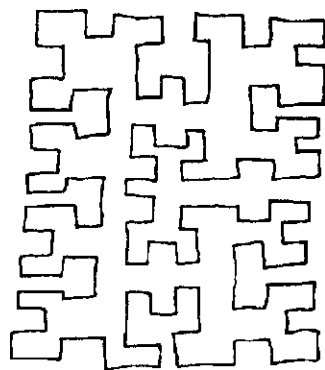
**EVEN  
VERTICES**

You can try the same thing with the letters of the alphabet.

**E** NO

**B** YES

Put a point somewhere in the middle of this figure. Is it on the inside or the outside? You can find it by drawing a line from the point to the outside, and counting the number of times the line crosses the drawing. If it crosses an odd number, the point is inside. Do you know why?



SHAPE	ODD VERTICES	IS IT POSSIBLE?
	4	NO
	0	NO
	4	NO

## THE MAN WHO PLANTED HOPE AND GREW HAPPINESS

This story of an unschooled shepherd has inspired millions across the world. A green classic.

In 1913 a young Frenchman Jean Giono was trekking in a remote and barren area in France. After a few days he was stranded without water and the scorching sun parched his throat. There he met an old shepherd with 30 sheep, who provided him with food and a resting place. Every day the unlettered old man - Elzeard Bouiffier planted 100 acorns in that devastated land. To count 100 he made 10 piles of 10 seeds each. Then he dug holes in the ground and sowed the seeds. The old man did not own the land. Who owned the land? That did not bother him. The land probably belonged to some rich people who didn't care about it, or maybe it was part of the commons. He only knew that the land was dying. This pained him deeply. To rejuvenate it, he planted trees. In 3 years he planted over a hundred thousand seeds. Out of which only 10,000 grew up. The rest either got burnt in the harsh sun or were nibbled by rats. Still there were 10,000 oak plants where there was nothing before.

Jean was unimpressed. He thought the old man was a crackpot - a crank. Some people collect stamps and coins. This man probably liked digging holes and sowing seeds.

Jean completed his journey and forgot all about this episode.

Soon he went to fight the First World War. After the war he got leave. Once again he founded himself travelling down the same road. He could not recognise the place. Perhaps the war had affected his memory. No, the place had actually transformed beyond recognition in the past six years. Instead of a treeless, erosion-scarred landscape, Jean could see a kind of hazy mist that covered the hills like a carpet. Everywhere young trees swayed in the wind. There was a scent in the air. Fresh water gushed from dried mountain streams.

Suddenly Jean remembered the old shepherd. The old man must be dead, he thought. What can an old man of fifty-five do, but die? This surely was not sun-scorched sheep country? Six years ago this land had been barren - almost dead. But now the vegetation was burgeoning - the air was tranquil and trees stretched as far as Jean could see.

The old shepherd was very much alive and all the while he was planting trees. Jean could scarcely believe the transformation. The old man took Jean for a long stroll into the forest. He nodded and gestured at the trees growing all around, with the pride of a father presenting his first-born.

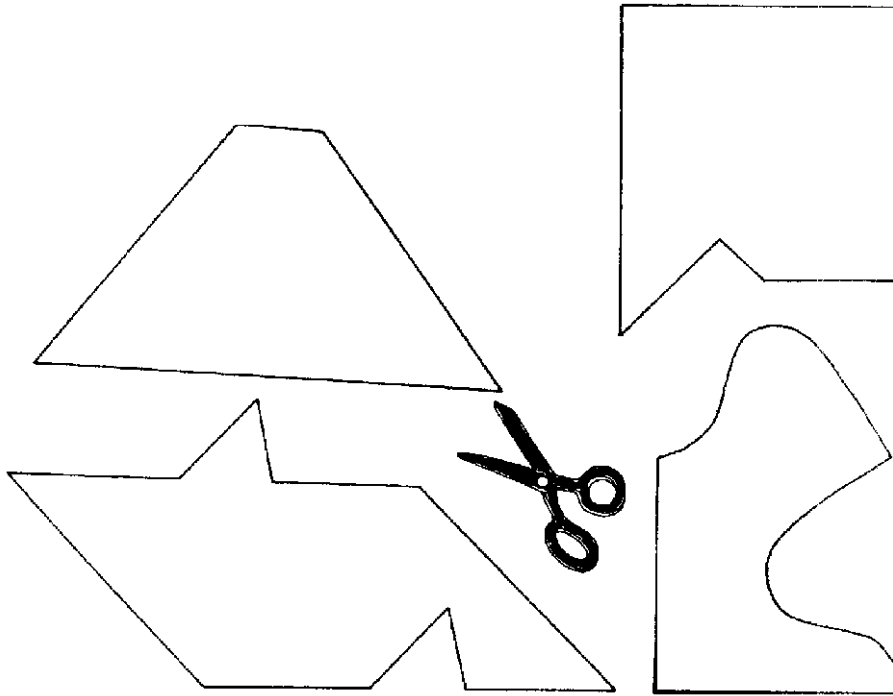
He was no longer a shepherd - he had only 4 sheep now, and instead looked after 1,000 beehives. A vast forest of saplings - oaks, beeches, and birches - stretched around them in three sections for a length of 11 kilometres and up to a width of 3 kilometres. Jean was struck dumb as the former shepherd led him all day around his shoulder high forest. It was incredible to imagine that in 1915, when Jean was fighting the First World War, the old man had been planting birches that now stood slender and delicate as young dancers. It was incredible that a forest could have sprung from the toil of one man's effort, from one man's vision and patient toil. Jean began to think. We have a choice, he thought - to either kill people in the name of nation, religion etc. or we can do god's own work by greening up the earth.

Now there were farms everywhere. Along the roads you met hearty men and women, boys and girls who understood laughter and delighted under the bountiful trees. All and all, more than 10,000 people owed their happiness to the unfailing greatness of spirit and tenacity of purpose of a single man - an old unschooled man who planted trees and grew happiness. At the age of 83 Elzeard Bouiffier died peacefully under a tree.

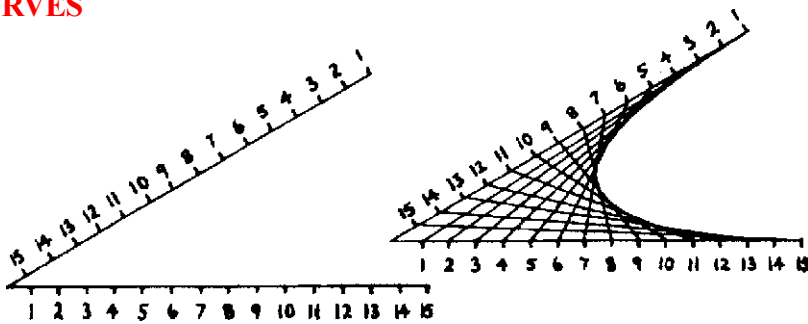


## SQUARE UP!

Copy these shapes on to another card sheet. There is something special about these shapes. Now with just one cut you should be able to divide the shape into two pieces, and then put the 2 pieces together to make a square!



## CURVES



If you throw a ball its flight is curved. Many objects move in a curved path. We can make curves from sets of straight lines. By joining pairs of numbers 1 to 1, 2 to 2 and so on you will make a curve from a straight line. Change the angle between the lines and see the difference.

**GIVE A MAN  
A FISH...  
AND YOU FEED HIM  
FOR A DAY.**



**TEACH A MAN  
TO FISH...  
AND HE'LL FEED  
HIMSELF FOR LIFE.**

## PALINDROME WOW!

A Palindrome is a regular number. It can be approached anyway. Look at it from the front or from the back. It looks the same. It can be any size – small or big. It can turn up anywhere – in your maths sum, house number, scooter number plate, telephone, anywhere.

You can get a Palindrome with a bit of addition.

Take **132** for instance. It is not a Palindrome. But reverse it and add to itself.

$$132 + 231 = 363$$

Sometimes it may take much longer for you to get to a Palindrome.

Take the number **68** for instance.

$$68 + 86 = 154 + 451 = 605 + 506 = 1111$$

Sometimes it takes a very-very long time to get to a Palindrome.

There are word Palindromes too. Like:

**DAD!**

**RADAR!**

**EVIL OLIVE**

**MADAM I'M ADAM**

**DO GEESE SEE GOD?**

**NEVER ODD OR EVEN**

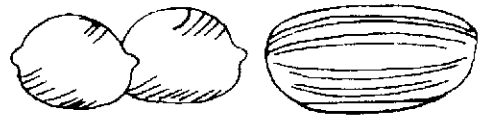
**MA IS A NUN AS I AM**

**A DOG! A PANIC IN A PAGODA!**

**CIGAR? TOSS IT IN A CAN, IT IS SO TRAGIC**



**NO LEMONS, NO MELONS**



## JUMPING RUBBER BAND

With an ordinary rubber band you can perform an extraordinary feat. You can make the rubber band jump from the little and ring finger on to the middle and index finger. It will take a little practice. But it is quite simple.

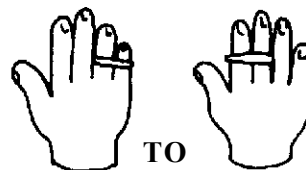
This is how it's done.

Put the rubber band around the 3<sup>rd</sup> and the 4<sup>th</sup> fingers. Pull it out so everyone can see. Turn your palm out and pull it again so they can see the other side. Then turn your hand back palm down, but as you do it, make a loose fist and stick your other 2 fingers under the band like this.

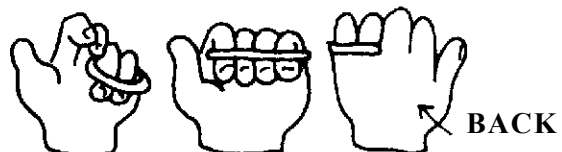
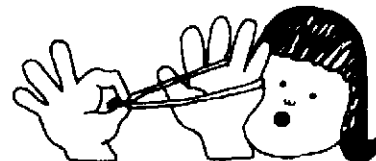
This is the part that will need some practice.

When you straighten your fingers, the rubber band will leap to your other 2 fingers!

When you are doing this trick, you are demonstrating a topological principal involving insides and outsides. Watch the rubber band closely as you do the trick.



TO



BACK

## FROM NET TO BOX

You will need some card sheet and scissors.

Cut five squares like this from thick paper.



Arrange them in different ways. Their edges must be touching.

And their corners must be neatly lined up.

This is wrong.

There are just a few ways - only 12. Find all 12. A golden rule to follow is: if one shape fits exactly on top of another, then they are the same.

Both these shapes  
are same.

This is right.

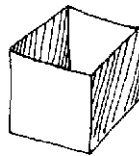
**X**

These shapes made from 5-squares are called pentominoes. Look at these pentominoes. **X** marks the bottom of the box. Now, look at the 12 pentominoes you've drawn. If you drew all 12, 8 of them should fold into boxes. Find them and mark the bottoms. Then cut them and fold them out to see if you are right.

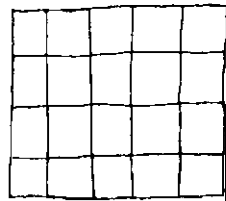
This one wouldn't  
fold up into a box.

This will fold up into an  
open box (without a lid).

A toy factory needs topless boxes like this.

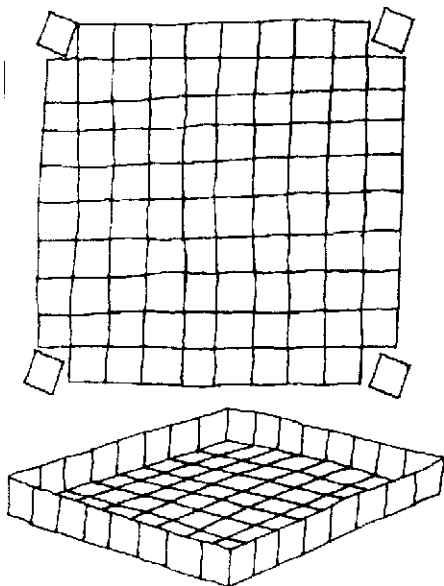


The purchase department has  
bought a lot of cardboard like this.



Each box takes 5 squares. Since there are 20 squares on out of each big sheet. How will they cut the cardboard?

## BIGGEST BOX



Cut a piece of paper with 100 small squares in it from a square notebook. Stick it on a thick paper to make it stiff. Cut one little square from each corner as shown.

Now fold it up to make a box. This box would be quite shallow and will not hold much.

What size squares would you cut from each corner to make a box, which will hold the most?

You could do this experiment with an old post card (size 9-cm x 14-cm). Make a box with a post card, which will hold the most?

This simple experiment connects the volume of the box with its surface area.

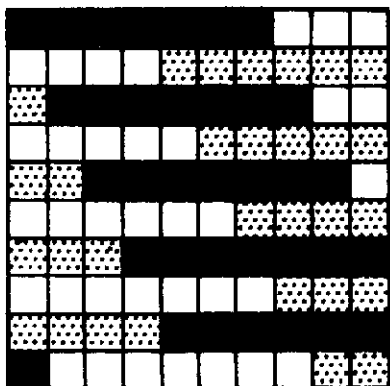


## EXPERIMENTING WITH PATTERN

Children often use a notebook with 1-cm squares (not graph paper) to add and subtract sums.

One can discover some beautiful patterns using a 'square' copy.

Fifty years back an American mathematician Leah Mildred Beardsley wrote an amazing book titled *1,001 Uses of the Hundred Squares*.



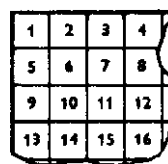
Make your own 100 squares. Choose a pattern and shade it in. Choose a number and see what kind of pattern you get. Can you discover what pattern the square above shows?

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Make a large number square and write the numbers. Place another card with windows cut out to show 'the threes' and other patterns on top of your square and see what numbers show through. We have cards for 'twos' and 'threes' placed on top of the 100 square. What pattern does it show?

100	90	80	70	60	50	40	30	20	
99	89	79	69	59	49	39	29		9
98	88	78	68	58	48	38		18	8
97	87	77	67	57	47		27	17	7
96	86	76	66	56		36	26	16	6
95	85	75	65		45	35	25	15	5
94	84	74		54	44	34	24	14	4
93	83		63	53	43	33	23	13	3
92		72	62	52	42	32	22	12	2
	81	71	61	51	41	31	21	11	1

The 100 squares can be numbered in different ways. Try as many different ways as possible and see what patterns you discover.



You need not always use a 100 square.

Do you know what the shaded numbers are? Can you see any pattern? Now shade in the same numbers using a spiral pattern.

1	2	3		5	6	7	8		10
11	12	13	14	15		17	18	19	20
21	22	23	24		26	27	28	29	30
31	32	33	34	35		37	38	39	40
41	42	43	44	45	46	47	48		50
51	52	53	54	55	56	57	58	59	60
61	62	63		65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	

	99	98	97	96	95	94	93	92	91
65		63	62	61	60	59	58	57	56
66	37		35	34	33	32	31	56	89
67	38	17		15	14	13	30	55	88
68	39	18	5		3	12	29	54	87
69	40	19	6	1	2	11	28	53	86
70	41	20	7	8		10	27	52	85
71	42	21	22	23	24		26	51	84
72	43	44	45	46	47	48		50	83
73	74	75	76	77	78	79	80		82

## LEARNING FROM GANDHI

*Bahuroope Gandhi* by Anu Bandopadhyaya, is a remarkable book. For children, it is the best book ever on Gandhi. The conception of the book is unique.

In 1964, Jawaharlal Nehru wrote in the foreword:

“It is extraordinary how in many things he took interest and when he took interest, he did so thoroughly. It was not a superficial interest. It was perhaps his thoroughness in dealing with what are considered to be the small things of life, which emphasized his humanism. That was the basis of his character.”

The book has been divided into 28 chapters, each depicting the ordinary aspects of an extra-ordinary man. Gandhiji's life as a toiler, barrister, tailor, washer man, barber, scavenger, cobbler, servant, cook, doctor, nurse, teacher, weaver, spinner, bania, kisan, auctioneer, beggar, looter, jail bird, general, author, journalist, printer-publisher, fashion-setter, snake-charmer, priest. Some of the caricatures are by the legendary R. K. Laxman; others by Nicky Thomas. This book needs to be translated in all languages of the world.

Gandhi did not simply preach. He lived his convictions. Nothing was menial for him. He laid emphasis on working with the hands. He believed that true learning involved the hands, the heart and the head. Instead of cramming from textbooks he wanted children to engage in productive work for society.



First published by Popular Prakashan in 1964. Republished twice by the NCERT (1970, 1995).

In 2004, republished as *Learning from Gandhi* by the Other India Press, Mapusa, Goa.

The entire text of the book can be accessed from <http://arvindguptatoys.com>

## THE BULL WHO LOVED THE SMELL OF FLOWERS

Seventy years back one Sunday afternoon in 1935, Munro Leaf decided to write a children's story so that his close friend Robert Lawson (a relatively unknown illustrator) could show his talents. In less than one hour, Leaf composed the beloved 800-word story.

When published in 1936 as *The Story of Ferdinand*, this anti-war book sparked controversy. With the Spanish Civil War waging, political critics charged it was a satirical attack on aggression. In Germany, Hitler ordered the book burned while fellow dictator Stalin granted it privileged status as the only non-communist children's book allowed in Poland. And India's spiritual leader Gandhi called it his favourite book. The passive resistance of a peaceful bull is being retold here:

Long time ago in Spain lived a small bull. His name was Ferdinand. All his friends did the whole day was to fight – they tried to poke each other with their sharp horns. But Ferdinand was different. He hated fighting. He loved one thing – the smell of flowers. There was a cork tree on top of a hill. Ferdinand liked to sit under the tree and enjoy the sweet scent of its blue flowers.

Ferdinand's mother sometimes worried about him. What good is a bull that doesn't fight? What will he do when he grows up? But she was very wise. So she let her son do what he liked.

Years passed and Ferdinand grew up into a very strong and powerful bull. One day five people wearing funny hats came from Madrid to choose the strongest bull - for the Bull Fight. At the sight of the selectors all the young bulls went mad. To show their macho they started fighting fiercely and poking each other with their horns.

Ferdinand was not interested in fights. So he climbed up the hill to sit under his pet cork tree. He did not look below. By mistake he sat on a bumblebee. The bumblebee stung him. Ferdinand cried with pain and ran like a mad bull.

The five men were delighted to discover Ferdinand. "We've found the strongest bull!" they exclaimed. So Ferdinand was tied up and carried away to Madrid for the Bull Fight. Lots of women also came to see the Bull Fight. Many women had flowers in their hats. Flags fluttered everywhere. There was music in the air.

There was a big parade. First came the Picadors with spears. In the end came the Matador. The Matador was supposed to fight the bull with his sword. In the end came – you know whom - Ferdinand. Everyone was terrified at the sight of the powerful Ferdinand. They called him 'Bloody Ferdinand!' Everyone expected a bloody, bull-fight.

Ferdinand ran and came to the centre of the fighting ring. People started clapping and cheering. They wanted Ferdinand to fight fiercely. But Ferdinand had his own ideas. When he reached the centre of the ring he smelled the scent of beautiful flowers. He sat in the middle of the ground enjoying the exotic aroma of flowers. Ferdinand decided not to fight or to kill anyone.

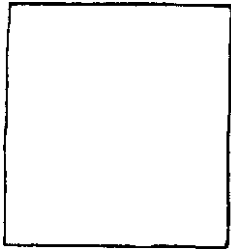
The fighters – Picadors and Matadors tried their level best to instigate Ferdinand. But Ferdinand did not budge. In the end Ferdinand was packed off home.

I think Ferdinand is still sitting under the shade of the cork tree and smelling its aromatic flowers!

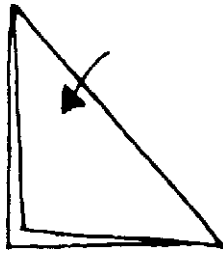


## FLAPPING BUTTERFLY

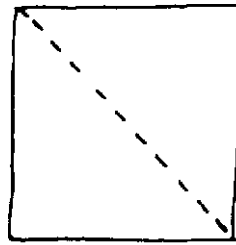
This simple paper butterfly flaps its wings like a real one.



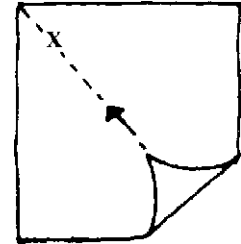
1. Take a 15-cm square paper.



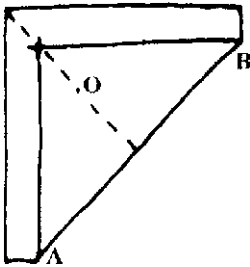
2. Fold it along the diagonal.



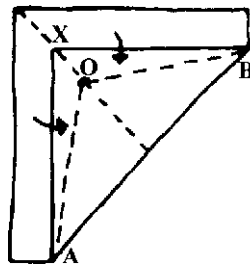
3. And reopen.



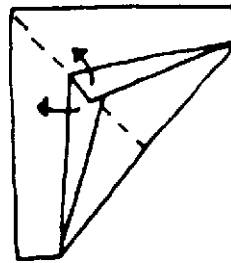
4. Fold right corner to X, 2-cm before the top left corner.



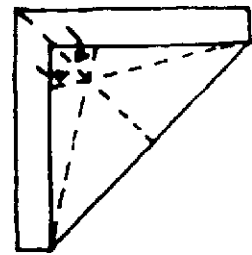
5. Mark a point O about 1.5-cm from X.



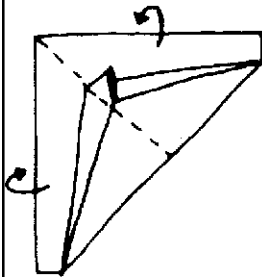
6. Crease the lines OA and OB.



7. Fold them up.

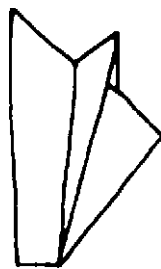


8. Fold little triangles into a standing nose.



9. Fold the model along the dotted diagonal...

(Pix by Anu Gopinath)



10.... into half.

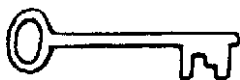


11. Cut along the dotted lines, to make the butterfly's wings and antennae.



12. Hold the front tip of the butterfly with your left hand and pull the arrow down with your right hand to make the butterfly flap its wings.

**DOUBT  
THROUGHOUT**

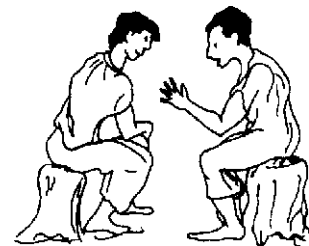


THE KEY TO THE  
SCIENTIFIC METHOD

*How* something is taught is just as important as *what* is taught.

And the most important part of how something is taught is caring, respect and shared concern that go into it.

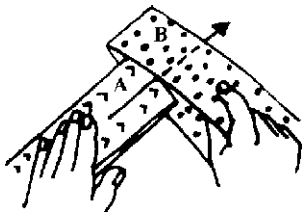
Aristotle, "Father of Science," wisely said...



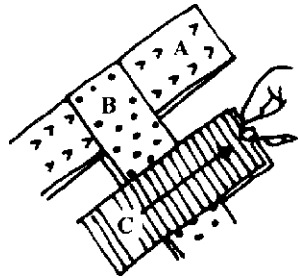
**HOW CAN I TEACH  
BUT TO A FRIEND**

## WOVEN FISH

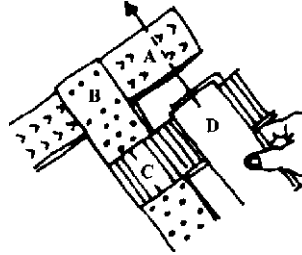
You will need several long rectangular strips of slightly stiff paper for weaving this fish.  
Fold four long strips of paper (2-cm wide, 50-cm long) in half. These strips have been shown in different designs and have been named A, B, C and D. Don't turn around the strips too much.



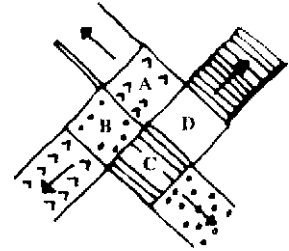
1. Take strips A and B and put A inside B as shown.



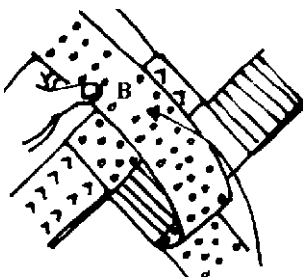
2. Weave strip C into place.



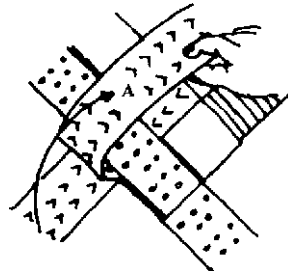
3. Now, weave strip D into place.



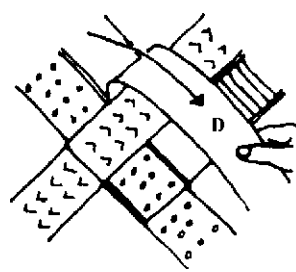
4. Pull the strips to make a paper knot.



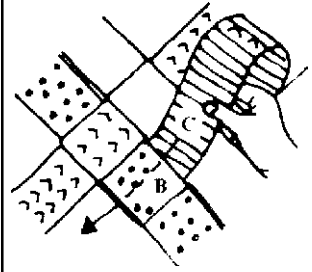
5. Fold the top layer of strip B up over the knot.



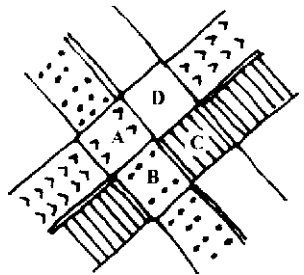
6. Fold the top layer of strip A up over the knot.



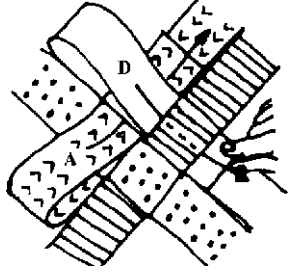
7. Now fold the top layer of strip D over the knot.



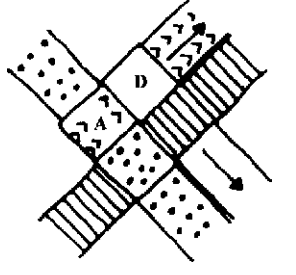
8. Fold top layer of strip C over the knot. Take care to weave it through.



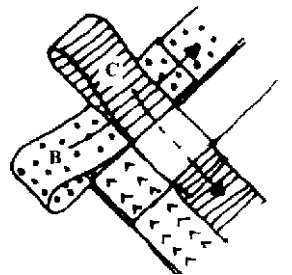
9. The design should now look like this.



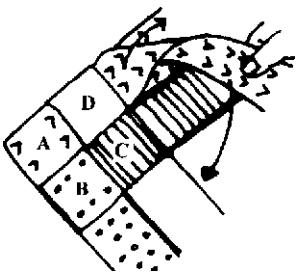
10. Fold over the bottom layers of strips A and D and weave them through.



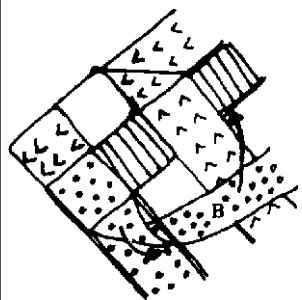
11. Pull the strips tight. Turn the paper over from top to bottom.



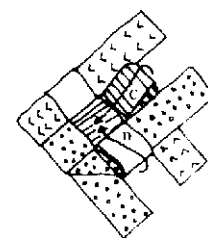
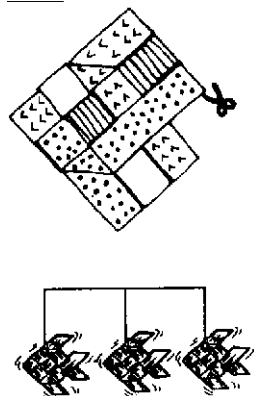
12. Fold bottom layers of B and C and weave them. Upturn paper.



13. Fold the top layer of strip A backwards.



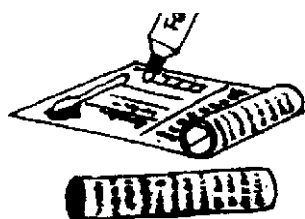
14. Fold the top layer of strip B backwards.



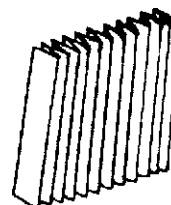
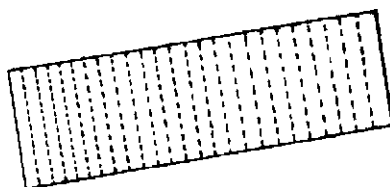
15. Trim each strip to the same length. Don't trim them too short. Tuck the double strips C and D inside the body of the fish. Cut ends to make the tail of the fish. Make a mobile.

## MAGIC FAN

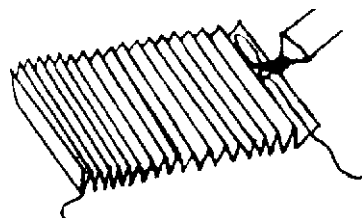
This captivating traditional folk toy could at one time be bought in village fairs.  
You can't buy it today, but you can still make it.



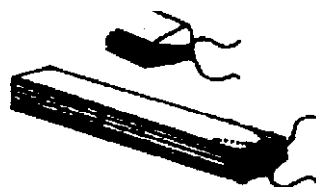
1. Roll and stick an old post card to make a cylindrical reel of 2-cm diameter.



2. Fold a sheet of glazed newspaper (Sunday supplement) 10-cm x 50-cm into a fan with 32 creases. Make sure that all the zigzag creases are of the same width.



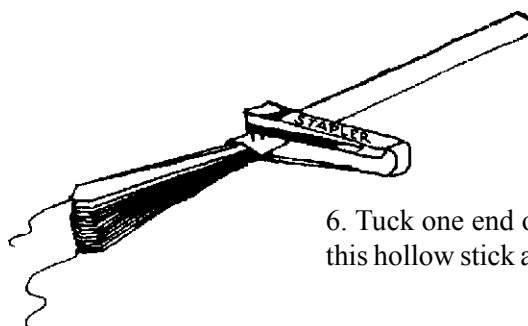
3. Fix a thread each on the two extreme ends of the corrugated fan. 5-cm of the thread should be left trailing out.



4. Trim the triangular edges of the folded fan as shown.



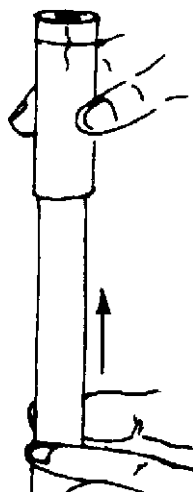
5. Cut a 20-cm edge square from a newspaper. Roll it into a hollow stick and glue its edge.



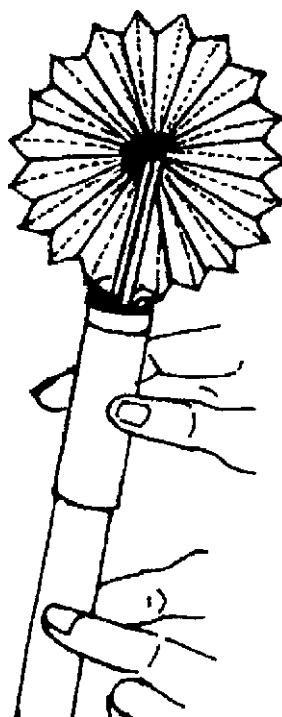
6. Tuck one end of the fan in this hollow stick and staple it.



7. Slip the postcard reel over the fan. The top of the reel and the fan should be at the same level, with the free ends of the threads hanging out.



8. Fix the threads to the postcard reel with cello-tape.



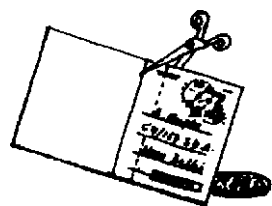
9. If you now hold the newspaper stick with one hand and slip down the postcard reel with the other, the fan opens out gloriously like the wings of a peacock. On sliding the reel upwards, the fan pleats fold in and settle snugly in the reel.

Before creasing the fan you can inscribe a message, such as **HAPPY BIRTHDAY** on it. On opening the fan the message will flash, much to the surprise of your friends!

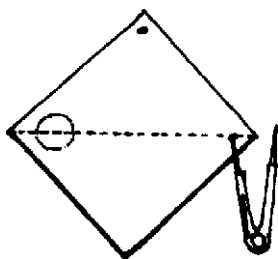


## LETTER BALANCE

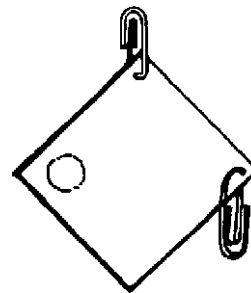
This simple balance is very convenient for weighing small letters.



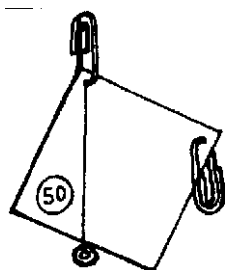
1. Cut a 9-cm square from an old postcard.



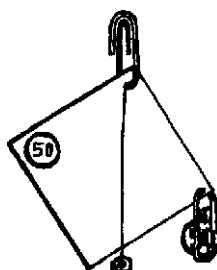
2. Draw a diagonal and poke two holes with a divider.



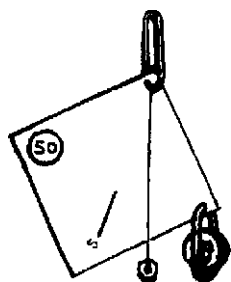
3. Insert paper clips in the two holes. The top clip will make the pivot. The right clip will hang the letters.



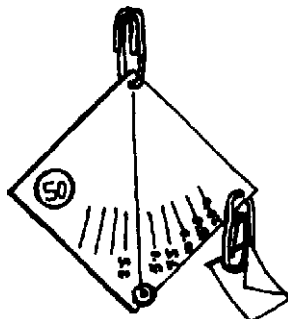
4. Stick a 50-paise coin (weight 5-gms) in the left corner. Tie a thread to the pivot clip and hang a small steel washer at its end. This will be the plumb line – always pointing vertically down.



5. Now suspend a 50-paise (the old 50-paise weighed 5-gms) from the right clip and mark the position of the pointer on the card. Again hang 7.5-gms (one old 50-paise and one old 25-paise coin) from the right clip and mark the position of the thread on the card.



6. Using the standard weights of coins indicate 2.5, 10, 15, 20-gms marks on the card.



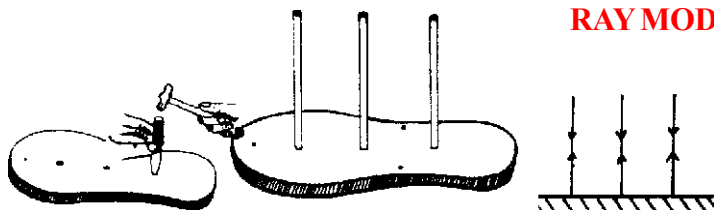
7. This calibrated balance can now be used to weigh letters.



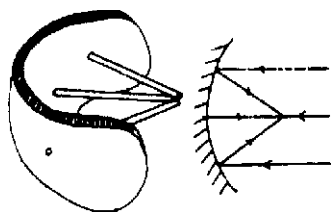
2 gms. 2.5 gms. 5 gms. 6 gms.

8. Some of the old coins (still in circulation) had interesting, easy-to-remember weights. These coins could be used as standard weights.

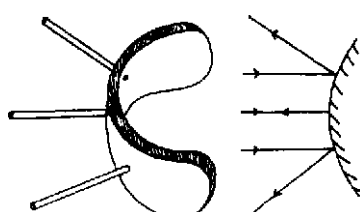
## RAY MODEL



PLANE MIRROR



CONCAVE MIRROR



CONVEX MIRROR

Punch out three holes 5-cm apart in an old rubber slipper. Press fit sticks or pencils in these holes. When the slipper is lying flat the sticks stand upright. If the slipper was a plain mirror strip, then light rays striking at right angles will retrace their path as shown.

What if it were a concave mirror? Just bend the slipper inwards and see. The three sticks now converge at a point called the focus.

What if it were a convex mirror? Bend the slipper the other way and you will see the sticks diverging.

As glass cannot be flexed and light rays are invisible, this model will help in concretising the ray diagrams of curved mirrors.



## FUN WITH STONES

When big-big stones  
Roll down the hill  
They hit and split  
In a tumble-mill.

Their corners rub  
And angles grind  
They feel so good  
They boggle the mind.

These rounded stones  
Some big, some small  
Two stones don't look  
The same at all.

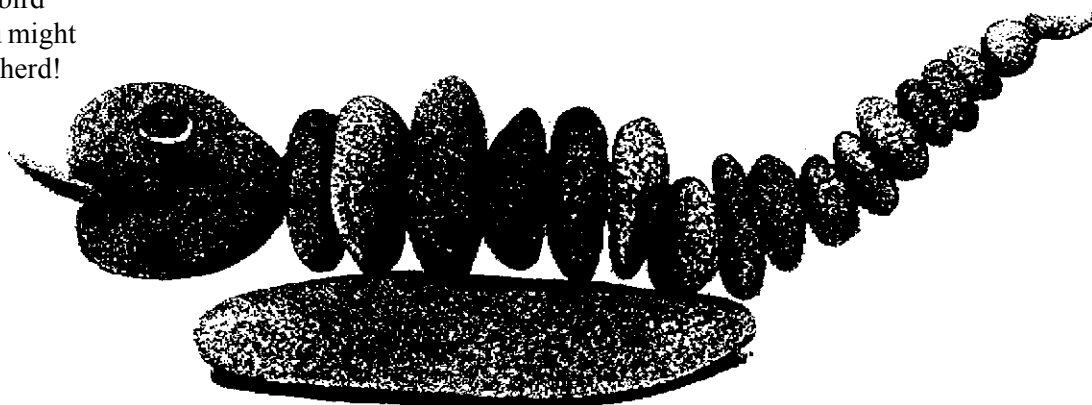
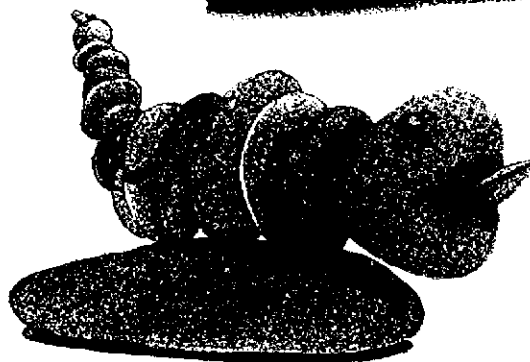
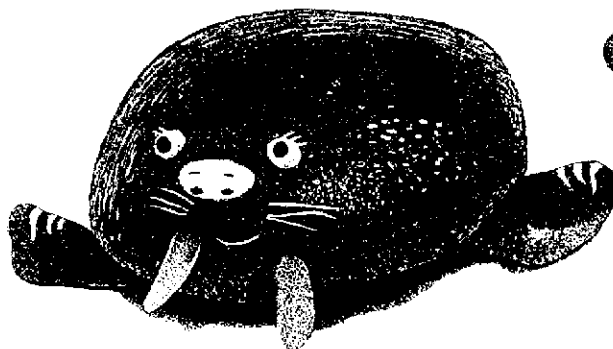
This little stone  
Will make a beak  
This rounded one  
Looks like a cheek.

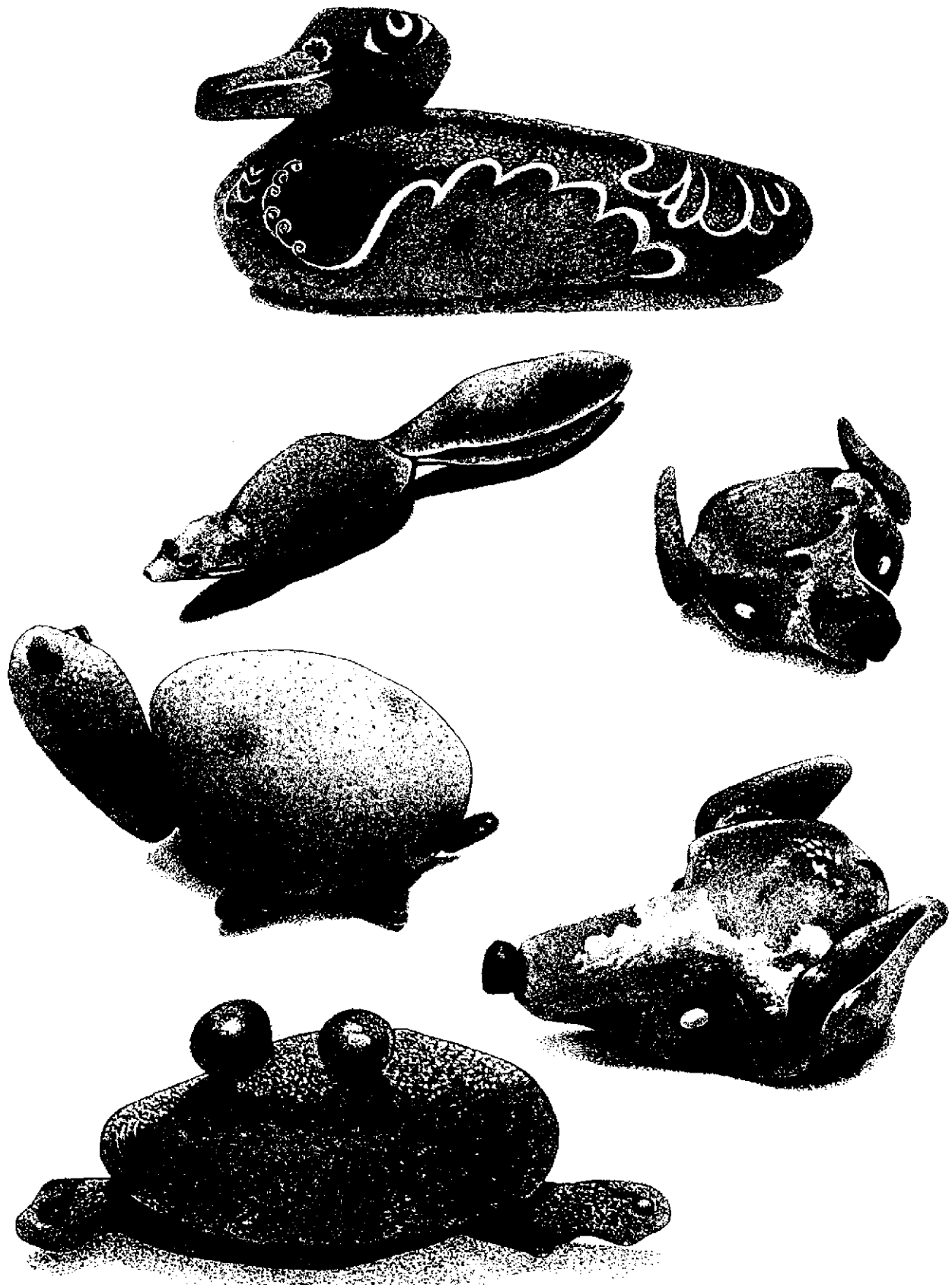
Look at these stones  
With a little love  
You'll find in them  
A stony dove.

Look up and down  
Then turn around  
Seek in the stone  
A sleepy hound.

Paint your pebbles  
Crisp and bright  
These lovely birds might  
Tweet at night.

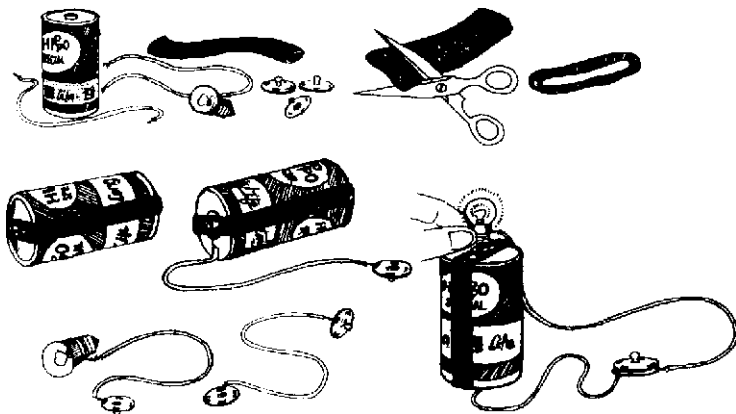
Put stone on stone  
To make a bird  
Some day you might  
Just make a herd!





(Pix: Avinash Deshpande)

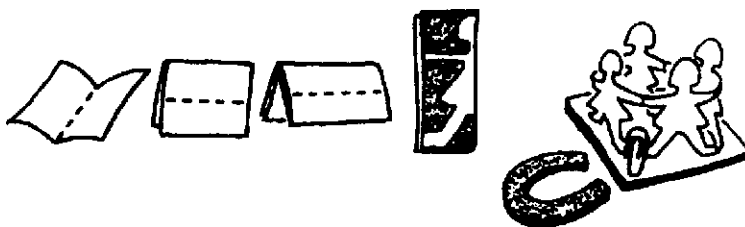
### PRESS BUTTON SWITCH



Cut a 1-cm wide rubber band from an old bicycle tube. Cut two circular holes at the diametrically opposite ends of this band. Stretch and slip the band on the battery. The positive top of the battery top sits in one hole. A press button half (with the pip) sits in the other rubber band hole at the bottom of the battery. Place the bulb on the battery top and snap close the two parts of the press button to close the switch. The bulb will light. Press buttons are made of brass so they don't rust.

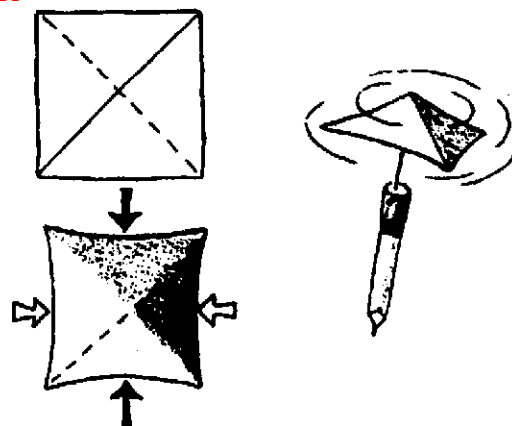
### DANCING DOLLS

Fold a stiff paper as shown and cut off the shaded portion. Form a circle of dolls by taping them. Attach paper clips for the dolls to stand on. Stand the dolls on a piece of cardboard. Bring a magnet from below to make them dance.

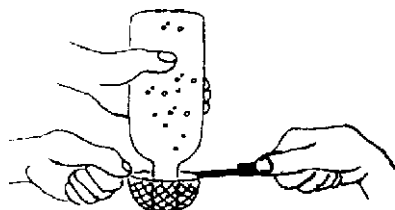


### HOT AIR TWIRLER

Cut a 7.5-cm square from the thinnest paper you can find. Fold along both diagonals to make a small roof. Next push a pin in the rubber of a pencil so that 2.5-cm of the pin juts out. Sit down and hold the pencil between your knees. Place the centre of the square on top of the pinhead. Place your cupped hands on either side of the paper. Within about a minute the paper fan will begin to turn. Keep your hands cupped close just leaving enough place for the fan to turn. The lighter the paper and warmer your hands the faster it turns. The hot air from your hands rises, turning the twirler.

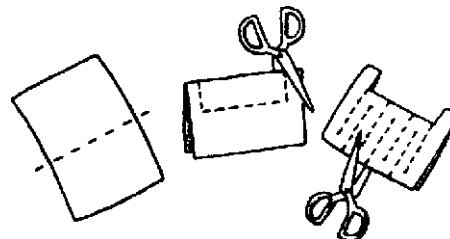


### WATER DOES NOT SPILL



Fill a bottle completely with water. Keep a strainer tightly against the mouth of the bottle. With the strainer held tightly against the bottle's mouth quickly turn the bottle upside down. The water doesn't run out. Surface tension is helping. It also helps to have the bottle full of water, so that there is no air trapped inside to push down on the water.

### WALK THROUGH A POSTCARD



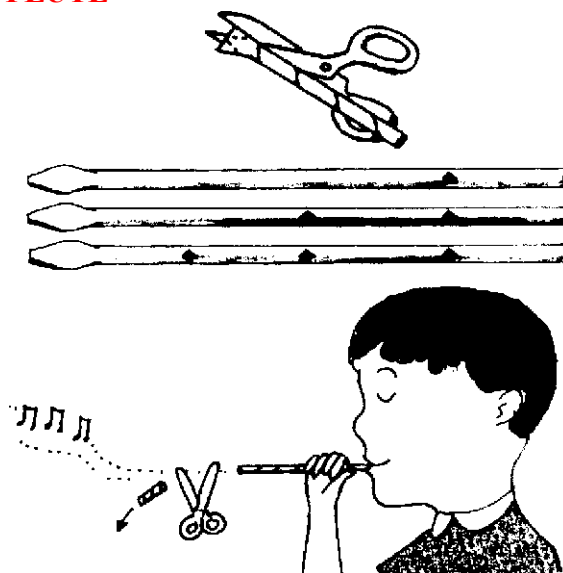
Fold a postcard down the middle from the top to the bottom. Cut a strip as shown. Then make seven or nine deep cuts (any odd number will do). The cuts must alternate between the fold and the edges of the card. Unfold the postcard and stretch it out. You can walk through the postcard without tearing it.

## FUN WITH DRINKING STRAWS

### STRAW FLUTE

The first wind instruments were probably hollow reeds picked and played by shepherds in the fields. You can make a flute with a plastic straw. The very soft or hard straws don't work well. You need a medium stiffness straw. Pinch flat 2-cm at one end of the straw. Cut off little triangles from the corners to form a spear shaped reed. Put the straw deep in your mouth and blow hard.

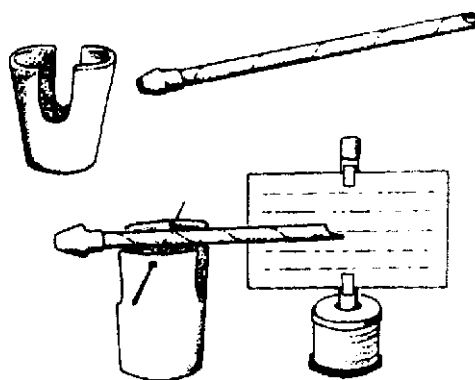
Later cut three small slits along the length of the straw about 2.5-cm apart. You can play a simple tune by covering and uncovering the holes. Make a long flute. Blow to make sound and simultaneously keep cutting the other end to make the straw shorter and shorter. You will be able to produce many melodious notes!



### MICRO BALANCE

This is a very sensitive balance.

Make two cuts on opposite sides of a paper cup as shown. Cut away part of one end of a straw to form a little scoop. Put some putty on the other end of the straw. Push a long needle through one-cup wall then through the straw and then the other cup wall. Tape a card sheet to a pencil and stand it in a spool. You can mark the weight of things you weigh on the card. An ordinary postcard (area 126-sq cm = 14-cm x 9-cm) weighs 2.5-gm. Each square-cm of the postcard weighs 20-milligrams. Use these to calibrate your microbalance. Weigh a grain of rice or wheat?



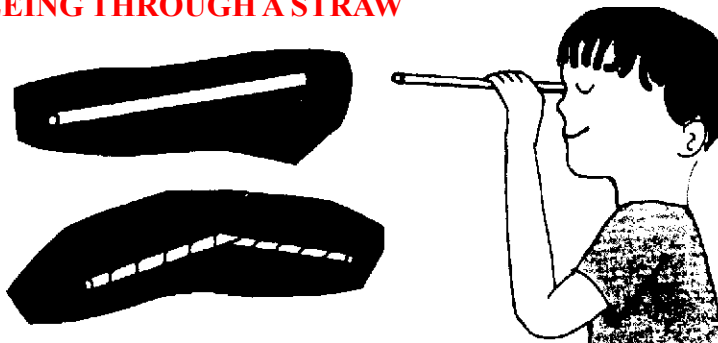
### SEEING THROUGH A STRAW

You can see clearly through a straight straw.

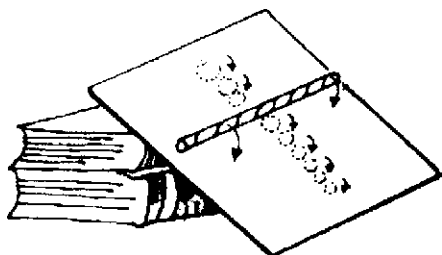
But what if the straw is bent?

Then you can't see.

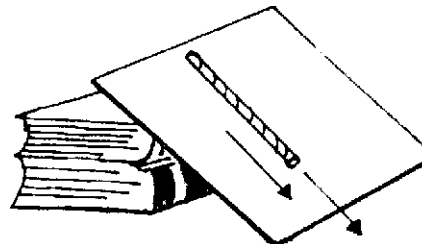
This is one way of showing that light does not bend and travels in straight lines.



### ROLLING AND SLIDING

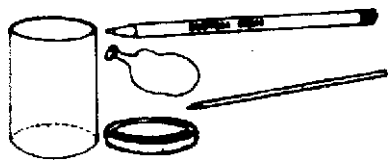


Keep a straw horizontally on a ramp. It rolls down. Now keep it vertically and it slides.

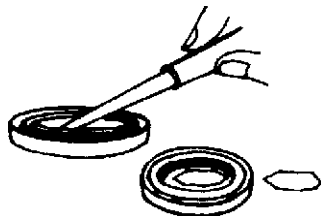


## BOTTLE BEEN

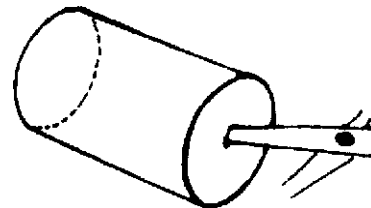
This toy will remind you of the *Been* – the snake charmer’s musical instrument.



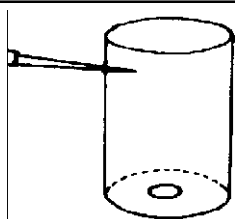
1. Materials needed to make it are a film reel bottle, a dry sketch pen, an old ball-pen refill, a torn balloon and ordinary hand tools.



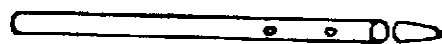
2. Cut the middle portion of the film bottle cap with a knife. The hole should be 1.5-cm in diameter. The shape of the hole is not important.



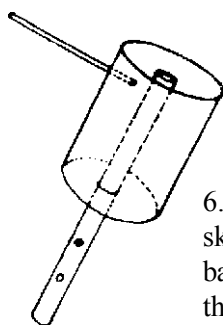
3. Make a hole in the centre of the base of the bottle. Widen this hole by rotating a tapered scissors. The hole should be large enough to squeeze a sketch pen through it.



4. Make a small hole on the cylindrical surface of the bottle about 1-cm from the open end. This hole should be just big enough to enable a ball pen refill to tightly fit into it.

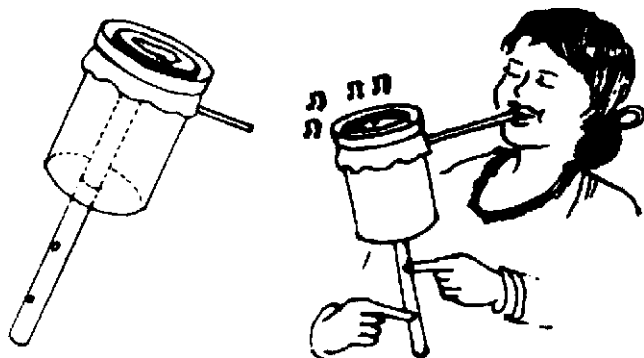
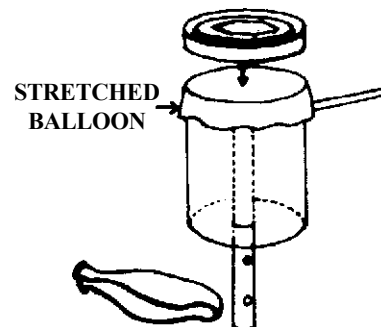


5. Cut the pointed writing end of the sketch pen. Make two small holes at a distance of 1 and 3-cm from this end.



6. Press fit the sketch pen and ball pen refills in the film bottle.

7. Cut a balloon. Stretch the balloon on the mouth of the bottle. Snap the cap on the bottle to keep the stretched balloon in place.



8. This is the complete assembly. Now gently slide the sketch pen upwards so that it just touches the stretched balloon. Simultaneously, blow through the refill. At one particular position you will hear a clear and loud musical note. By opening and closing the holes, as in the case of a flute, you can play a few notes. The balloon acts like a stretched membrane or diaphragm and begins to vibrate when you blow in. The bottle acts like a sound box.

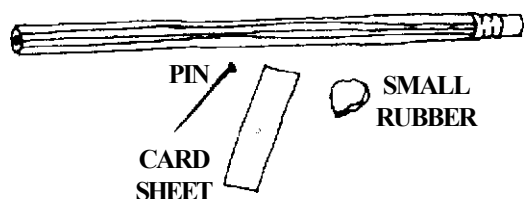
If you want lasting results:  
**POINT**.....but don't push



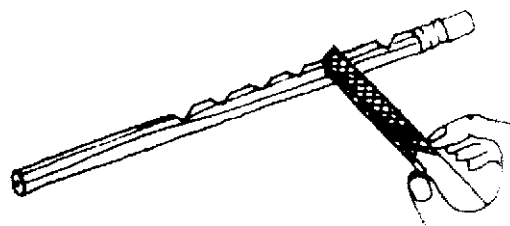
People will move by themselves  
once they see the need clearly  
and discover a way.

## PERPLEXING PENCIL

This toy has been around for over a hundred years.  
It has been a darling of physicists and has been quite a hit with children. It is very easy to make it.



1. You need a pencil with a rubber on one end, along with a paper pin, thick card sheet, a small piece of rubber and a penknife or a triangular file.



3. Cut a 5-cm x 1.5-cm rectangle from a greeting card. Mark its diagonals and make a hole in its centre. This makes the propeller fan.



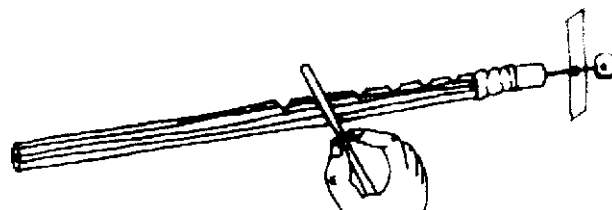
4. Poke a paper pin through a small piece of rubber. The rubber acts like a stopper and prevents the fan from flying away.



5. Weave the pin through the fan and insert it deep into the rubber end of the pencil. Make sure the fan rotates smoothly on the pin.

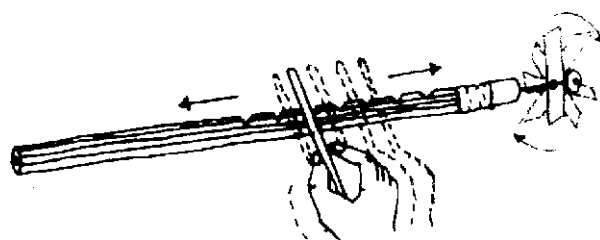


6. Now rub an old ball pen refill along the notches of the pencil.

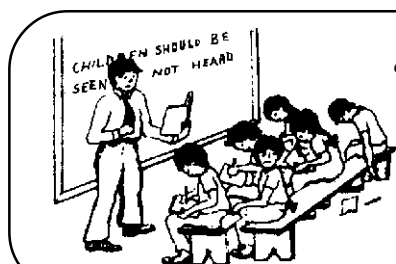


7. For best results hold the refill near one end and rub it hard. The fan will start rotating.

Can you make the fan rotate in the opposite direction? Children have been doing this for a long time by pressing the index finger of the hand holding the pencil next to the rubber on the pencil. Will the fan rotate if you rub it with your finger? What can the biggest size of fan? The fan rotates because of the vibrations in the pencil produced by the refill. The physics behind the toy is a bit complex and several learned research papers have been written on it!



(Pix: Anu Gopinath)

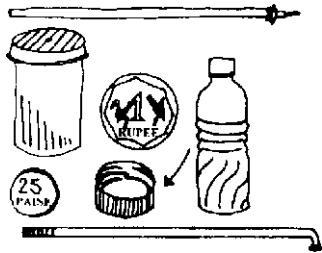


**"The lecture method of teaching is the best way to transfer the teacher's notes to the student's notebooks without ever passing through their minds."**

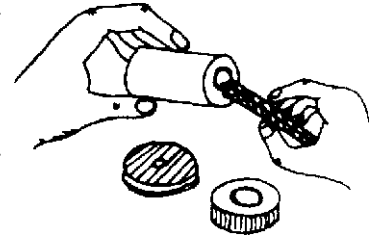
## WATER PUMP

You need a water bottle cap, which can fit into the film bottle like a piston.  
Two coins are used as valves in this pump.

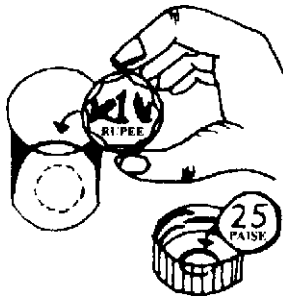
1. You need the following materials: a film roll can, one-rupee coin, 25-paise coin, used *Add-Gel* pen refill, mineral water bottle cap, a bicycle spoke and simple hand tools.



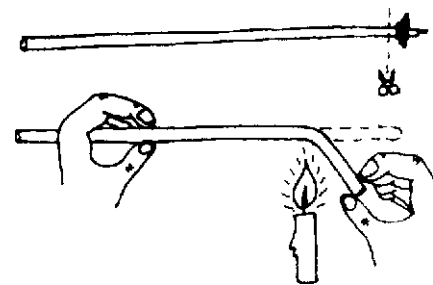
2. Make a 1-cm diameter clean hole in the base of film bottle. Make an 8-mm hole in the base of the water bottle cap. Make a small hole in the centre of the film bottle cap so that an add-gel refill can snugly fit into it.



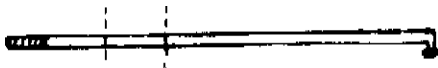
3. Put a one-rupee coin in the film bottle and a 25-paise coin in the water bottle cap.



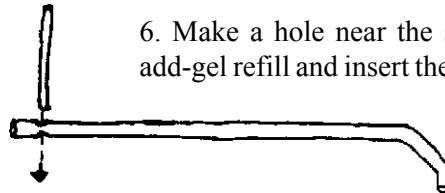
4. Cut a 10-cm clear *Add-Gel* pen used refill. Heat the refill gently to bend it on one end.



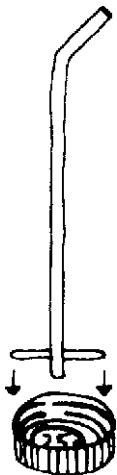
5. Cut a small piece from a cycle spoke (exactly the diameter of the water bottle cap).



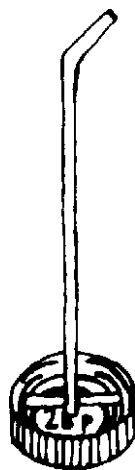
6. Make a hole near the straight end of the add-gel refill and insert the cycle spoke piece.



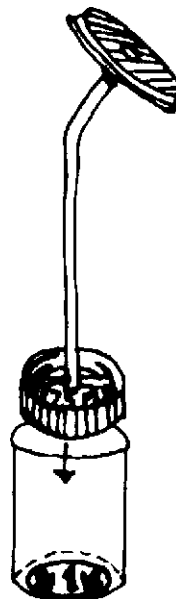
7. Rotate the cycle spoke in the water bottle cap so that it gets wedged between the internal threads of the cap.



8. The refill will act both as a connecting rod as well as a delivery pipe.



9. Put the water cap piston assembly in the film bottle. Shut the lid.



10. The water pump is now ready. Hold it in a glass of water and move the *Add-Gel* pen refill up and down. The coin valves will open and close. Water will gush out in every upward stroke.



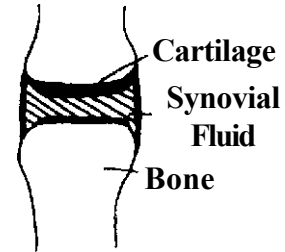
(Pix: Anu Gopinath)



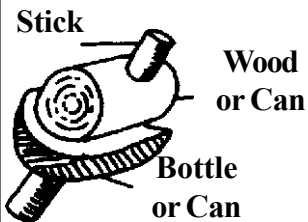
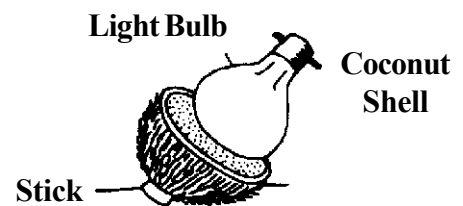
## BODY BONES AND JOINTS

Our skeletons, like those of many animals, are made of bone. Muscles are attached to the skeleton. Joints allow movement between bones, each type allowing movement in a particular direction. Joints and limbs, are moved by muscles. Muscles can only pull, not push, so they always occur in places where there is something pushing. Muscles not only give movement, they also support parts of the skeleton.

Joints prevent the bones from wearing away. The end of the bone is covered by a layer of cartilage, which is slightly springy and so acts as a shock absorber. Between the two layers of cartilage is a lubricating fluid, the synovial fluid. Collect some bones from the butchers to demonstrate particular joints.

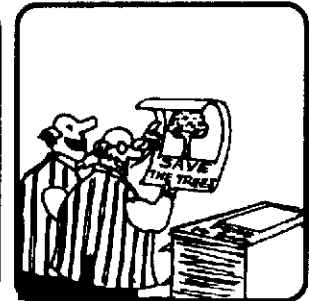
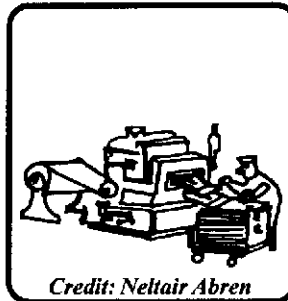
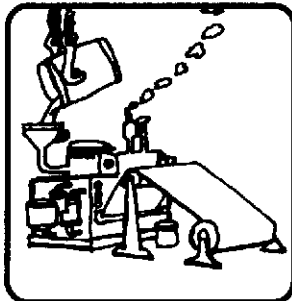
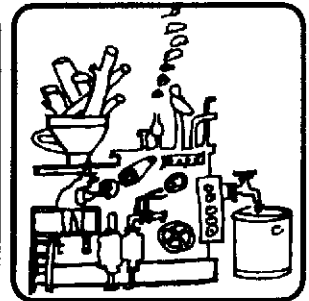
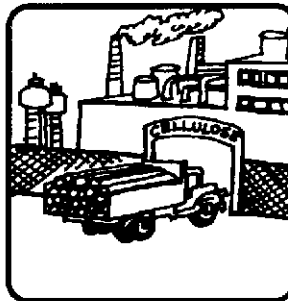
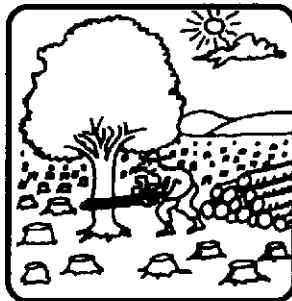
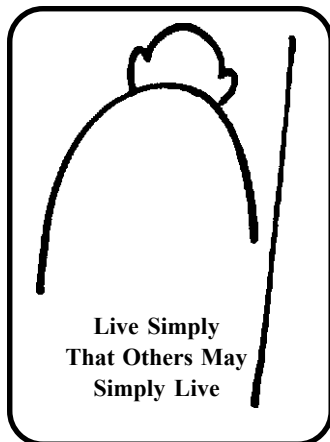
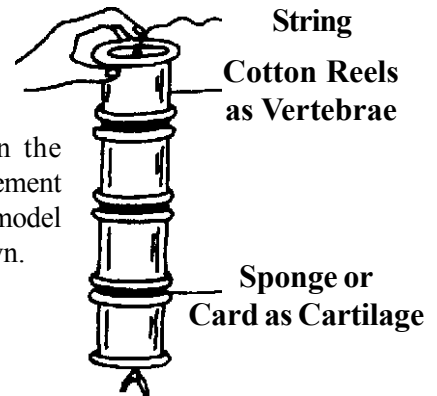


The hip joint, which allows the thigh to move is a ball and socket joint. You can demonstrate such a joint by cupping your hands and moving them as shown.



The elbows and the knee are both hinge joints and allow movement in only one direction - like a hinge. You can make a model of a hinge joint as shown.

The joints between the vertebrae allow movement of the spine. Make a model of the spine as shown.



Credit: Neltair Abren

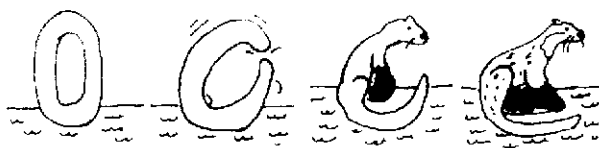
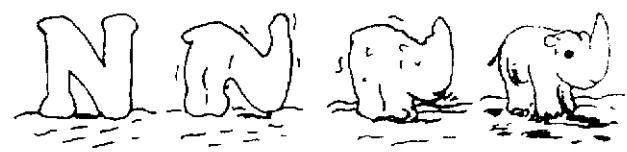
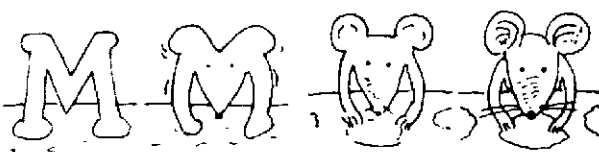
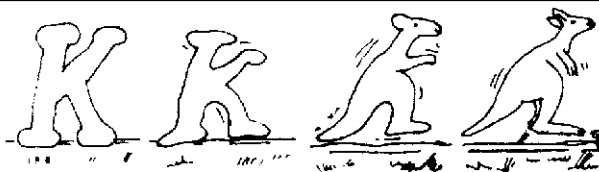
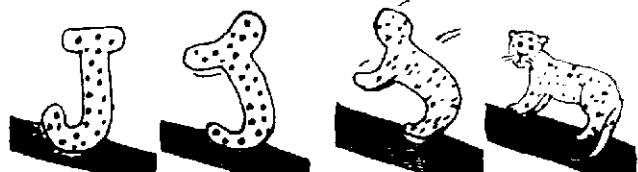
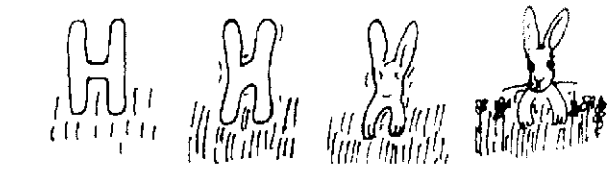
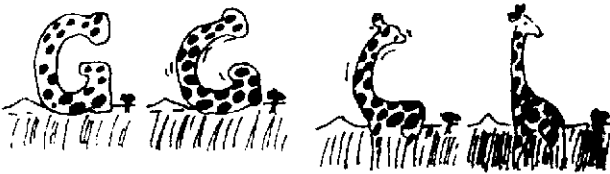
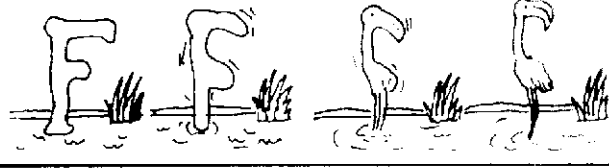
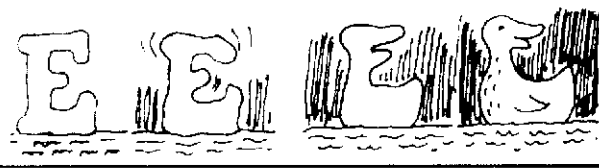
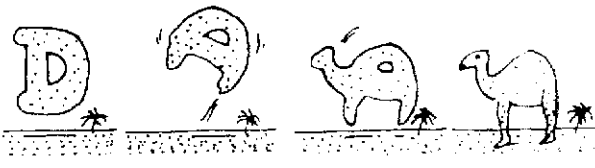
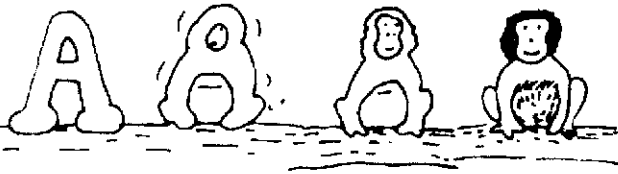
## MORPHING

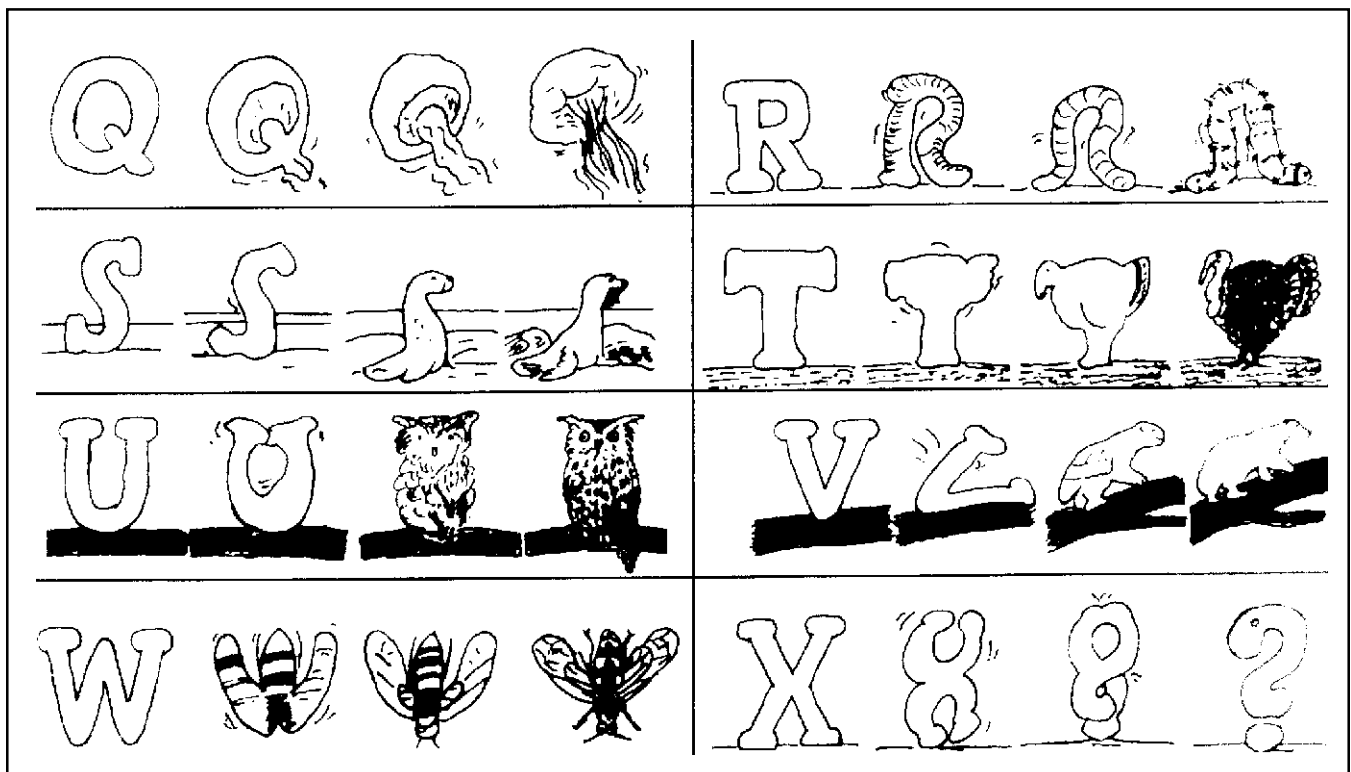
Morphing is a technique where by a form gradually transforms into another.

The familiar alphabets have been used to illustrate the point.

You could of course transform a stone into a face in a few steps!

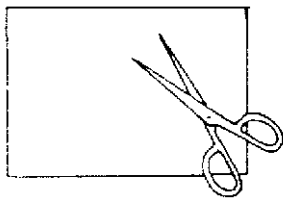
Computer animation techniques have made morphing very popular.



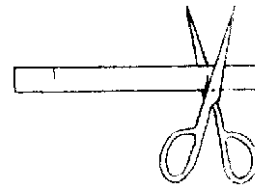
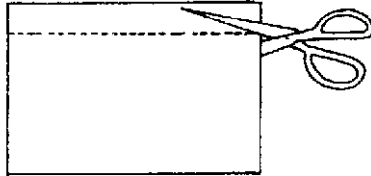


### FLYING FISH

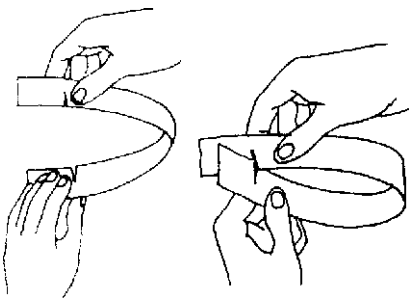
This fish is fun. It twists and turns and comes down like a Zeppelin plane!



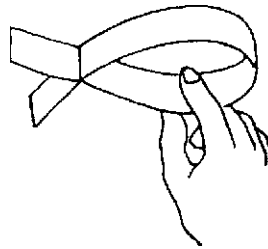
1. Cut a long strip of paper about 2-cm wide.



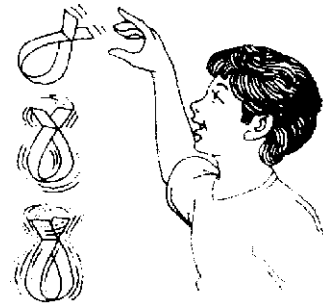
2. Leave 1-cm from the ends and cut halfway slits as shown.



3. Interlock the slits to make...



4. ... the Flying Fish.



5. Throw it in the air see it come tumbling down.



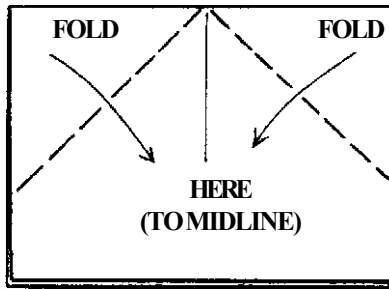
6. Experiment with different papers, shapes and sizes of fishes.

## PRINTER'S HAT

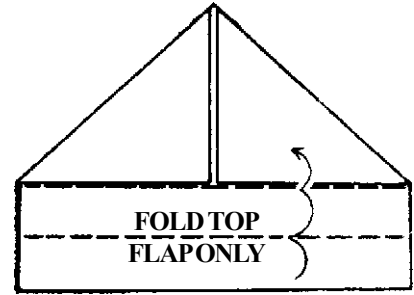
This is a very easy and useful cap. You can wear it in the sun. On inverting, it becomes a good box.



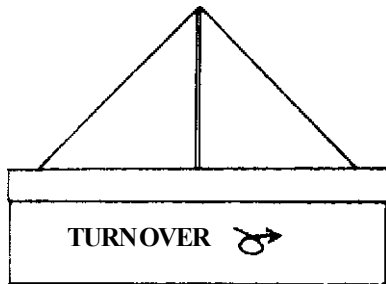
1. Take one old double spread newspaper and fold it into half.



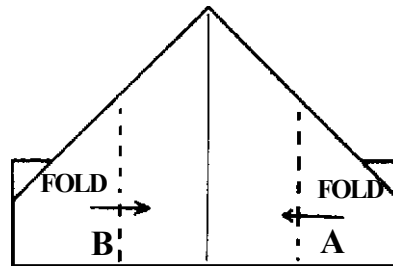
2. Keep the folded edge on the top. Fold the top left and right corners to the vertical midline.



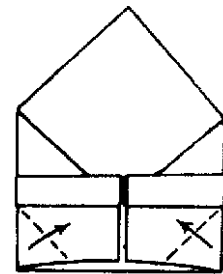
3. Fold only the top layer of the paper from the bottom into half. Then double fold.



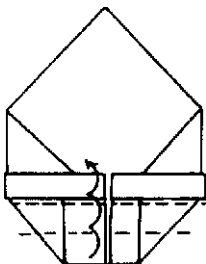
4. Now turn over the paper.



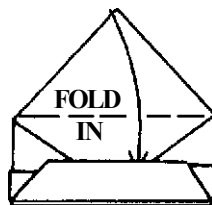
5. Bring the left and right edges to the midline and crease.



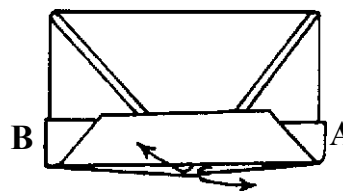
6. Fold the bottom left and right hand corners.



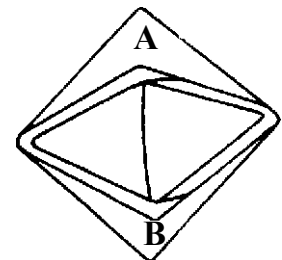
7. Fold the bottom portion in half. Fold it up once again and tuck the edge inside.



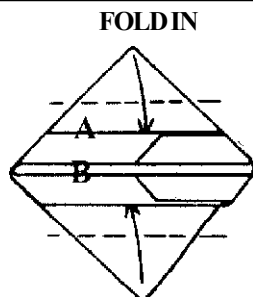
8. Fold the top point to the midpoint on the base and tuck in.



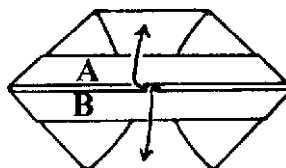
9. Open out the long edges.



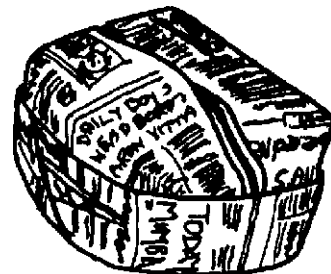
10. So that point A meets point B.



11. Bring the top and bottom corners to the centre and tuck them in.



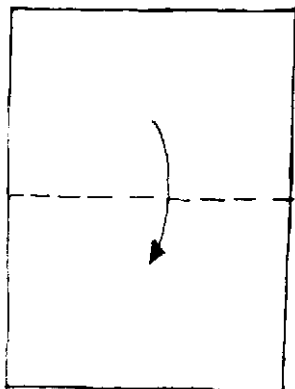
12. Now open out the midline and shape the model into a lovely cap.



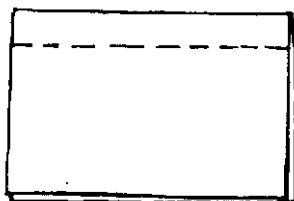
13. The inverted cap makes for a lovely box. With another cap you can make a lid for the box.

## NEHRU CAP

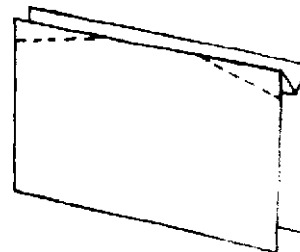
Boys in rural schools still wear this national cap to school. It just needs half a newspaper.



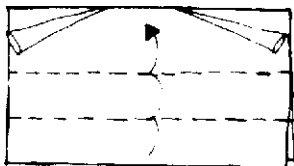
1. You just need a single sheet of newspaper for making this cap. Fold it in half from top to bottom.



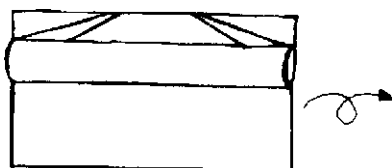
2. Fold a strip of 3-cm from the top into a channel.



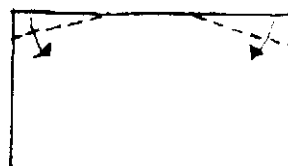
3. Fold the left and right hand corners of the top layer along the dotted lines as shown.



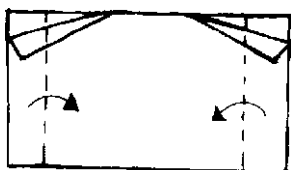
4. Fold the bottom edge of the top layer twice over along the dotted lines.



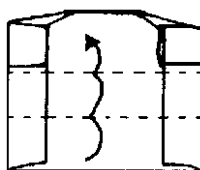
5. At this stage the model will look like this. Now turn over.



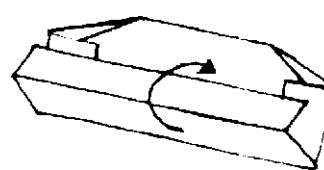
6. Fold the left and right corners along the slanted dotted lines as earlier.



7. Fold the two vertical edges inwards along the dotted lines.



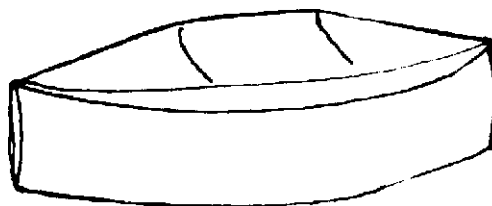
8. Fold the bottom edge twice over along the dotted lines.



9. Finally tuck the flap into the pocket.



10. This cap can be made to fit any size of head by adjusting the vertical folds in step 7.



11. This sleek and elegant cap can be flattened when not in use.

*(Pix: Avinash Deshpande)*

## DANCING DUO

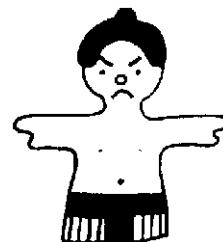
This traditional Chinese / Japanese toy is simple to make and great fun to play with.



1. Trim a few coconut broom sticks (6-cms) to uniform length.

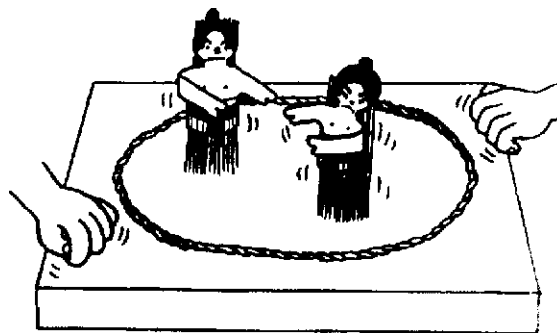


2. Tie them into a flat mat with string.



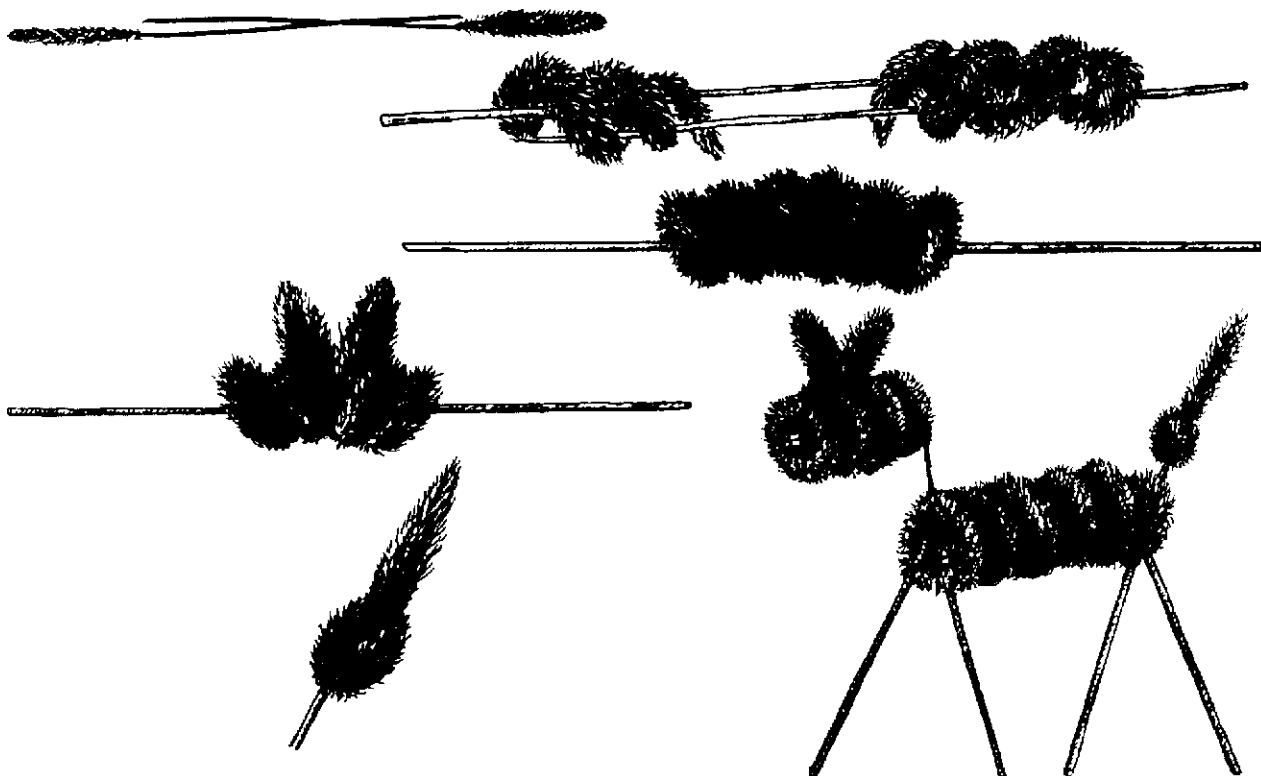
3. Cut a doubled up card sheet into a Sumo wrestler.

4. Stick the broom sticks on the wrestler to make it stand. Stand the figure on a cardboard box or an inverted metal "thali" and tap. The figures will execute a dance. They may appear like fighting Sumo wrestlers.



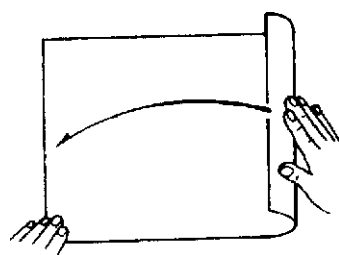
## VELCRO GRASS ANIMALS

This grass is popularly known as Velcro grass. During monsoons it easily sticks to clothes. Collect this sticky grass and join it together to make some beautiful animal figures.

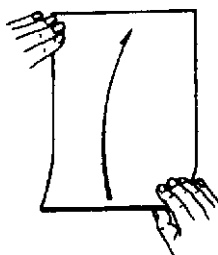


## BOOKLET

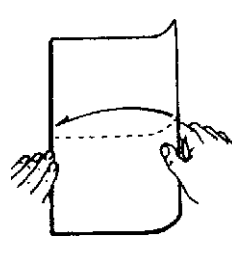
This booklet is very easy to make and can be used for making a small brochure, or picture book.  
To make it you will need a sheet of white photocopy paper and a scissors.



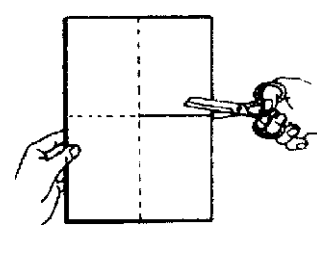
1. Place the sheet of paper on a table. Fold it half from right to left.



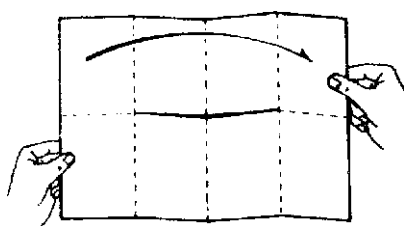
2. Fold and unfold it in half from bottom to top.



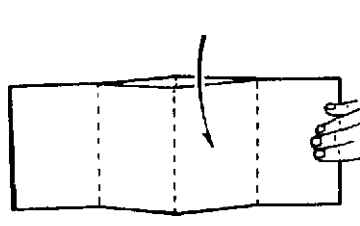
3. Fold and unfold it in half from right to left.



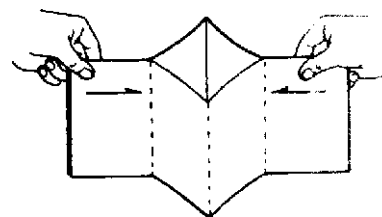
4. Cut from the right folded side into the middle of the paper, as shown.



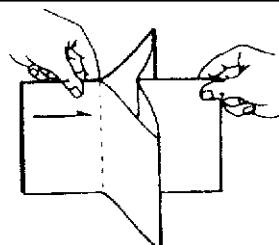
5. Open out the paper completely.



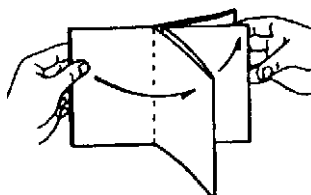
6. Fold it in half from top to bottom.



7. Hold the paper as shown, and push your hands together. The two centre layers will start to separate, making the middle pages of the booklet.



8. Fold the pages of the booklet together.



9. Using your imagination to make a lovely picture book.

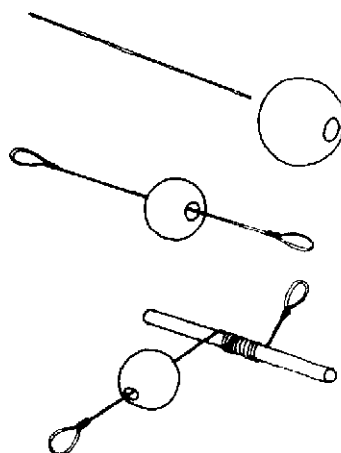


## SPIRAL BEAD

Take a 40-cm long thin wire. Make a loop on one end. Thread a bead on to the wire from the open end and then make a loop at this end too. Make sure that the sharp points of the wire on both the loops are pressed firmly and safely. Wind the looped beaded wire over an empty thread spool to shape it into a spiral.

Remove the wire carefully from the spool and stretch it by gently pulling it lengthwise, creating an elongated spiral.

As you hold the spiral the bead will roll down in a very intriguing manner.

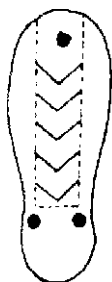


(Pix: Aga Khan Foundation)

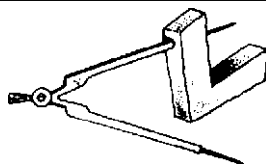


## CLIMBING CAT

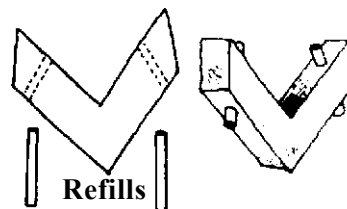
The material required is an old rubber (*Hawai*) slipper, a divider, one used ball pen refill, one small bamboo or ice-cream stick, thin but strong thread, and a few matchsticks. You also need an old magazine to keep the rubber for cutting. This will protect the knife blade.



1. Cut a 5-cm strip from the rubber slipper. Cut "V" shapes from this slipper.



2. Use the compass point to make two holes in the "V" rubber pieces as shown. The holes should be at a slant.

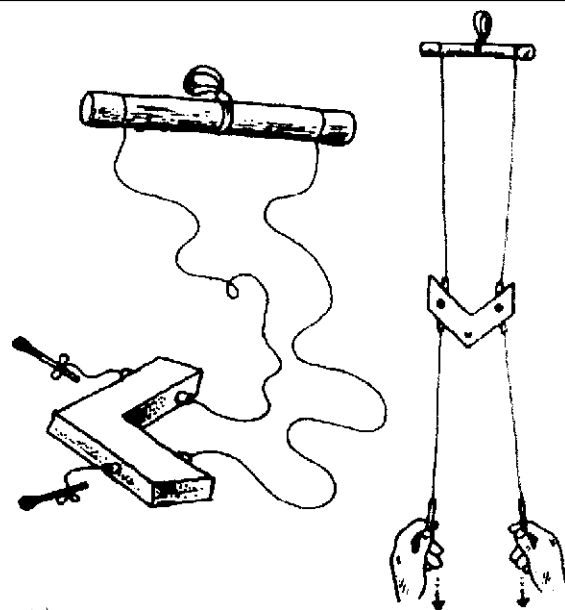


3. Insert small pieces of used ball pen refills in the rubber holes.

4. Take two 125-cm long pieces of strong but thin thread. Tie them tightly to the ends of a 12-cm long bamboo stick. Make a notch in the middle of the stick. Tie a loop of thread in this notch. The notch will prevent the loop from sliding.

Weave the threads through the two refill pieces of the "V" rubber. Finally tie two pieces of plastic straw or two matchsticks to the ends of the threads. Now hang the middle thread loop of the stick on a nail.

Hold the matchsticks in your hands, and pull the thread so that it is tight. Now pull the left and right hand threads alternately. You will find the "V" rubber piece climbing up. On loosening the tension in the strings it slides down. If you make two eyes and a mouth on the "V" rubber it almost looks like a climbing cat.



(Pix: *LOW-COST, NO-COST TEACHING AIDS* by Mary Ann Dasgupta)

They chop down 100-ft trees  
To make chairs.  
I bought one.  
I am six-foot one inch.  
When I sat on the chair  
I am four-foot two.  
Did they really chop down a 100-ft tree  
To make me look shorter?

- Spike Milligan



## JACOB'S LADDER

The Jacob's Ladder was an extremely popular toy during the late nineteenth century.

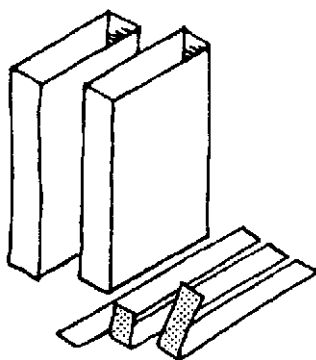
The toy takes its name from the *Bible*. In his dream prophet Jacob saw a ladder extending from earth to heaven on which angels could be seen coming and going.

The design of the Jacob's Ladder is extremely simple.

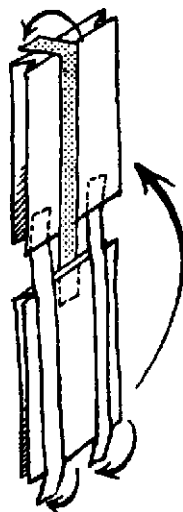
Basically a chain of cardboard rectangles are connected to one another by means of paper or cloth strips.

The strips are connected to the cardboard pieces in such a way that an illusion is created of the cardboard pieces tumbling or falling over one another when the toy is used.

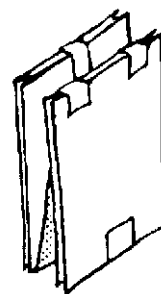
You will need two cigarette packets, scissors, glue and strips of paper white on one side and tinted on the other.



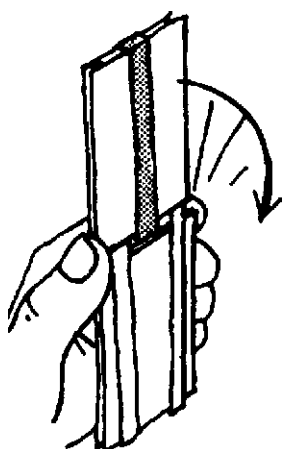
1. Take the outer shell of two cigarette packets and squash them to make V shaped channels on the sides. Cut 3 strips of paper. They should be 3-cm longer than the cigarette packets.



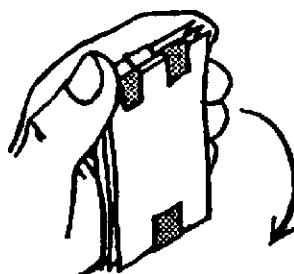
2. Stick the paper strips to the cigarette packets as shown.



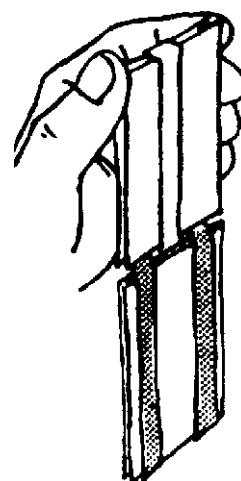
3. Fold the toy in half.



4. When you hold the toy at the centre of the packet and give it a gentle nudge then the other packet comes down.



5. Repeat the same process.



6. With every flip the paper hinges change colour.

## SCHOOL IS A WAR AGAINST THE POOR!

In the late 1960s a book entitled *Letter To A Teacher* was written by a group of Italian peasant children from the School of Barbiana. The school was not an Italian State school, nor was it a public school for the wealthy middle-class. It was founded by a young radical priest Don Lorenzo Milani and was named after a community of about twenty farmhouses that lay in the Mugello region of Tuscany. Originally intended as a night school for working people it soon became evident that the children of the region were being let down by the state schools, they often failed exams and were discouraged by the nature of authoritarian education.



Don Milani gathered together a small group of children and, over a many long hours, they formed a system that was more relevant to the needs of the poor. The older children actually began teaching the younger children and many “failures” became successful. Don Milani died in 1967 and the school died with him. But the book that the children wrote became a world wide best seller.

The schoolboys of Barbiana lucidly examined the class bias of public schools. Using clear (and angry) language, challenging ideas, armed with data and examples the children exposed the variety of overt and covert mechanisms used by schools to discriminate against poor students.

*Letter to a Teacher* brought about many themes that still resonate strongly today. Among them are the problems of two-tiered education systems, of emphasizing testing and grades, of rating schools, of teacher’s authoritarianism, of poor quality education for poor children, of irrelevant curricula, of repetition and dropouts, and of business-like management models in schools.

The first paragraph of the book announces the angry and eloquent tone of the remainder of the text:

*Dear Miss, You don’t remember me or my name.*

*You have flunked so many of us.*

*On the other hand I have often had thoughts about you, and the other teachers, and about the institution which you call ‘school’ and about the kids that you flunk. You flunk us right out into the fields and factories and there you forget us.*

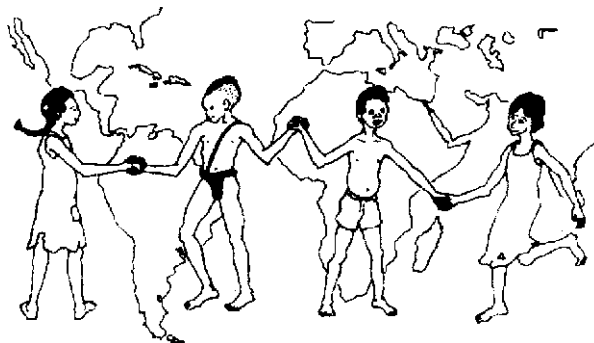
The children of Barbiana feel that, “**school is a war against the poor!**”

They say the school system often makes the children of the poor feel worthless, lazy or stupid.

These Italian school boys join hands with the children of the world saying:

“In Africa, in Asia, in Latin America, in southern Italy, in the hills, in the fields, millions of children are waiting to be made equal.

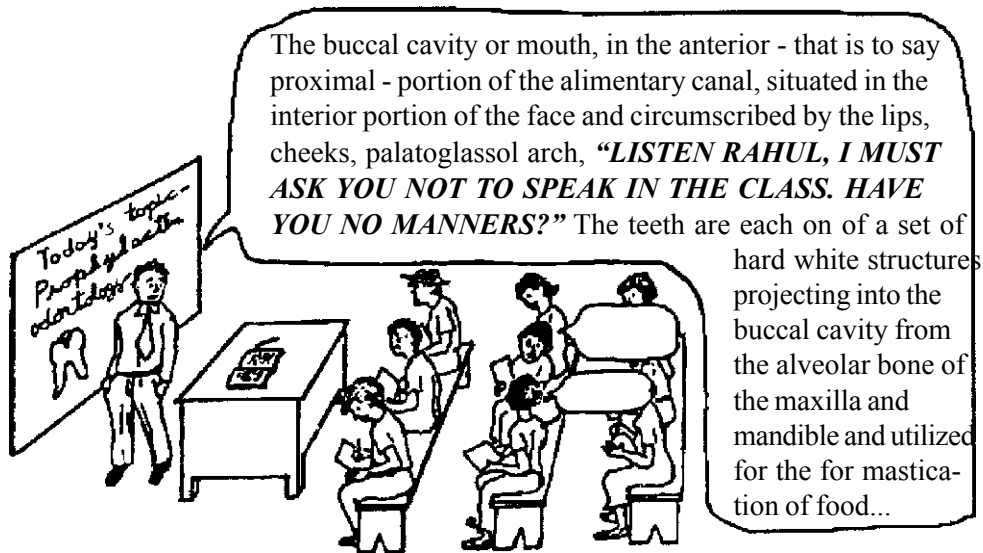
Shy like me,  
stupid like Sandro;  
lazy like Gianni.  
The best of humanity.”



(Pix: *HELPING HEALTH WORKERS LEARN* by David Werner)

## THE BOSSY TEACHER

The teacher talks over the heads of bored and confused students like this:



This lecture goes on and on – all very serious.

At the end of the class the teacher may simply walk out.

Or he may ask the children some questions like,

***"RUPA, WILL YOU GIVE ME THE DEFINITIONS OF CARIES?"***

and when he gets no answer, scolds her by shouting,

***"SO, YOU WERE SLEEPING TOO! THE GROUP HAS THE ATTENTION SPAN OF 5 YEAR OLDS!"*** and so on.

## A GOOD TEACHER

Would encourage children to sit in a circle, so that they can see each other's faces.

Would try and 'draw out' information out of the students from their own experience.

Would be careful and use words the students understand.

Would ask lots of questions.

Would encourage children to think critically and figure out things for themselves.

Emphasise the most useful ideas and information

(in this case what the children can do to prevent tooth decay).

Use teaching aids that are available locally and are as close to real life as possible.

For example a young child could be invited to the class

so students can see for themselves

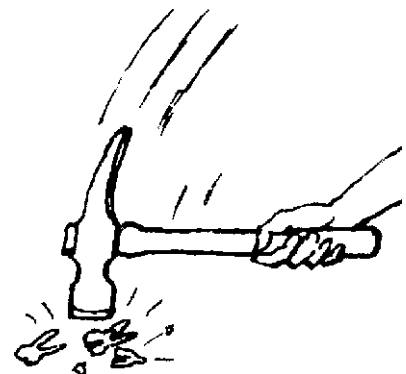
the difference between baby teeth and permanent teeth.

Have student's look in each other's mouths for cavities.

Pass around some rotten teeth that were pulled at the health centre.

Let children smash the teeth open with a hammer or rock, so that they can see the different layers (hard and soft) and how decay spreads inside a tooth. Ask someone to draw the tooth on the blackboard.

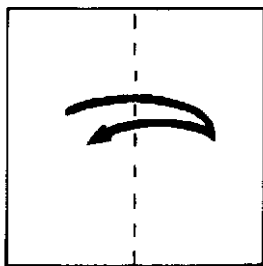
Encourage children to relate what they have seen and learned to real needs and problems.



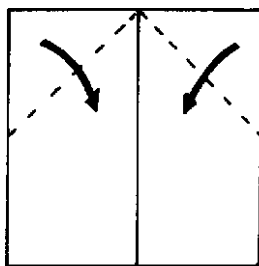
(Pix: *HELPING HEALTH WORKERS LEARN* by David Werner)

## TALKING FROG

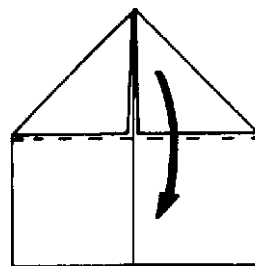
The talking frog is a very dynamic and interesting paper model.



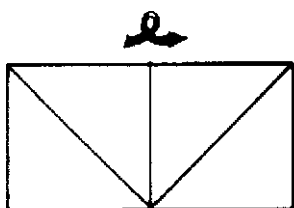
1. Fold the left edge over to the right and unfold.



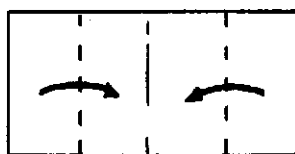
2. Fold the top corners in the crease.



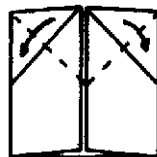
3. Fold down the top triangle.



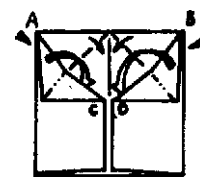
4. Turn over.



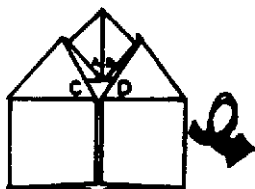
5. Fold the sides in to the middle.



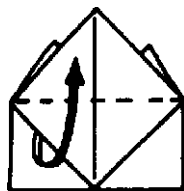
6. Fold the top inside corner of each flap to the outside edge.



7. Reverse fold A and B in to the centre crease to lie behind C and D.



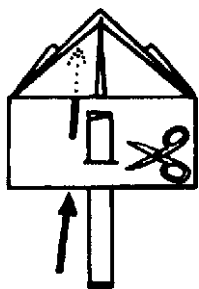
8. Turn over.



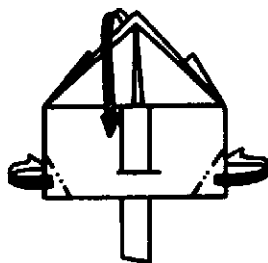
9. Fold the bottom corner of the diamond up to the top.



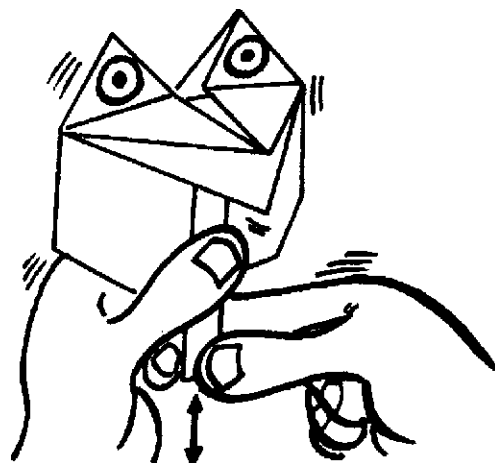
10. Fold over and over a strip of paper, which is a little longer than the height of the model.



11. Make a small tear across the middle of the model near the bottom edge. Put the strip through the tear and push it up under the top triangle as far as it will go.



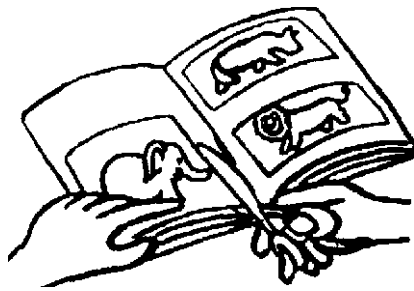
12. Fold the bottom corners behind. Fold down the front and back triangles at the top to make the mouth come forward.



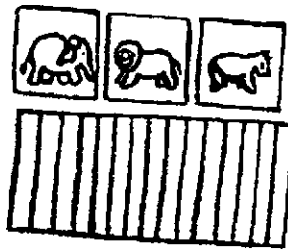
13. The Talking Frog is now complete. Draw the eyes. Hold as shown and move your right hand up and down. The frog will talk.

### THREE-WAY PICTURE

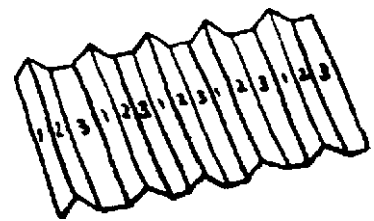
For making this delightful display you will need - three pictures from an old magazine, trimmed to the same height, a piece of thin cardboard, scissors, pencil, ruler and glue.



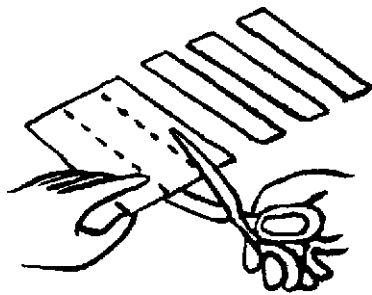
1. Trim the pictures.  
Label them 1, 2 and 3.



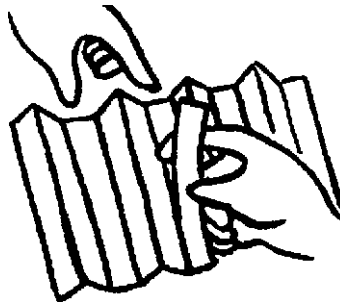
2. Cut thin cardboard to the same height and total length of all the pictures.



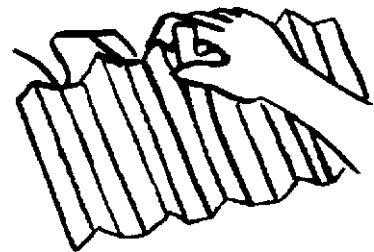
3. Mark the cardboard into 1-cm sections. Number the sections and fold the cardboard along the lines, as shown.



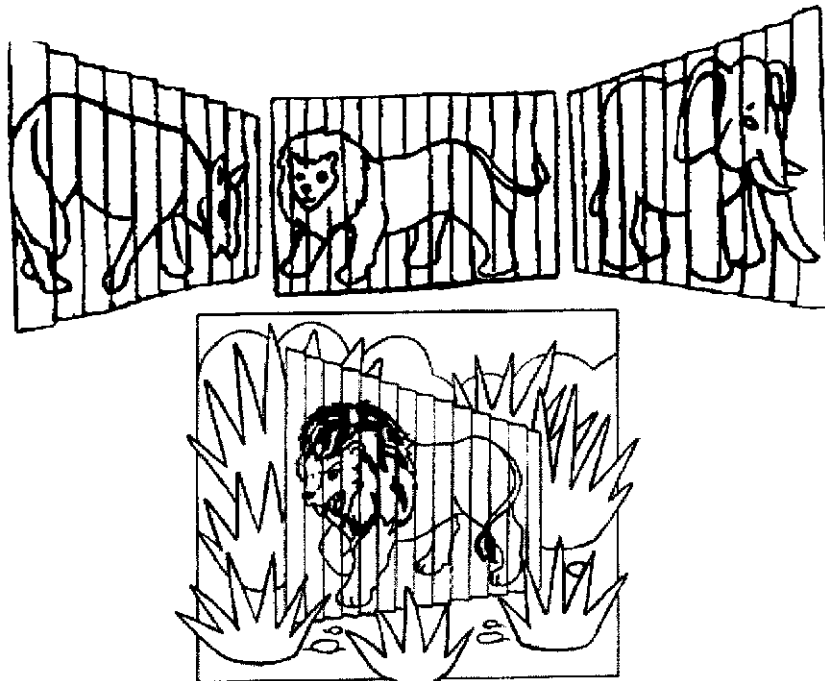
4. Mark each picture into 1-cm sections. Cut each picture into strips.



5. Glue the strips from picture 1 (in order) onto the sections marked 1.



6. Glue the strips from pictures 2 and 3 (in order) in the same way.

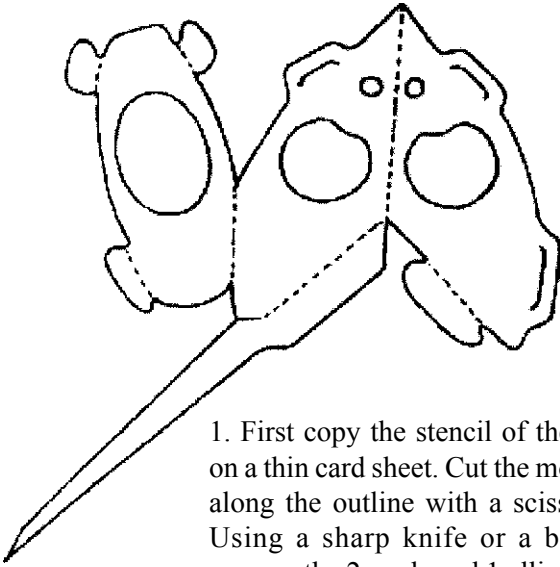


7. Stand the cardboard up and you will see a different picture from the left, the front and the right.

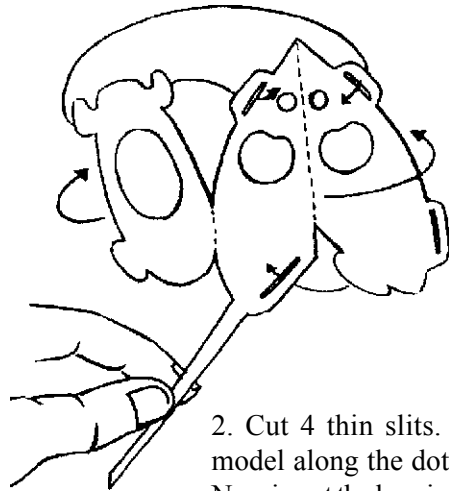
(Pix: Avinash Deshpande)

## MARBLE MOUSE

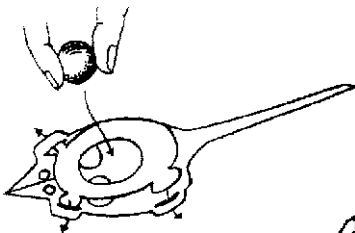
A truly marvellous mouse. Esther of *Play Rights*, Hong Kong presented it to me.



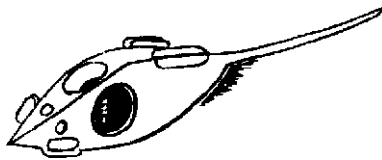
1. First copy the stencil of the rat on a thin card sheet. Cut the mouse along the outline with a scissors. Using a sharp knife or a blade remove the 2 ovals and 1 ellipse.



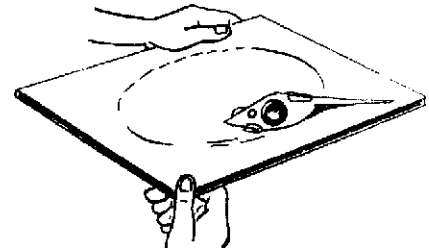
2. Cut 4 thin slits. Fold the model along the dotted lines. Now insert the lugs into the slits (you can also stick them), to give the mouse its 3-D shape.



3. Next insert a marble through the elliptical hole in the stomach of the mouse.



4. The mouse is now all ready to roll.



5. Place the mouse on a file cover and it will start rolling. You can make the mouse go round and round in circles.

## DIGITAL COMPUTER

In your head and hands you've got a computer!

It's a marvellous machine that can make multiplications by 9, for example a very simple operation.

Let's multiply 4 by 9 just to show you how your digital computer works.

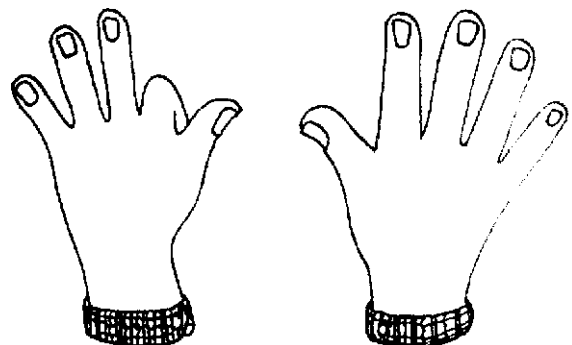
Hold out your hands.

Count off from left to right until you reach the fourth finger. Fold it down.

Now look at your hands and you've got the answer: there are 3 fingers to the left of the folded finger and 6 to the right: the answer is 36.

Try it out a few times and you'll find it never fails.

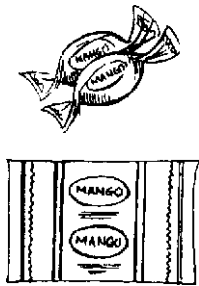
Show your friends how to multiply  $3 \times 9$ ;  $7 \times 9$ ;  $5 \times 9$ ;  $8 \times 9$  and  $9 \times 9$  on their fingers.



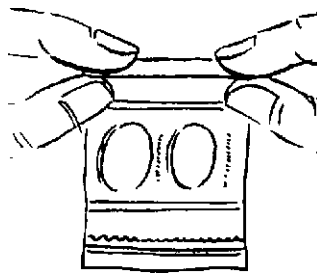


### TOFFEE WRAPPER WHISTLE

This whistle is a children's delight, but a teacher's nightmare.



1. Toffee wrappers are not for throwing, for you can make a lovely whistle out of them.



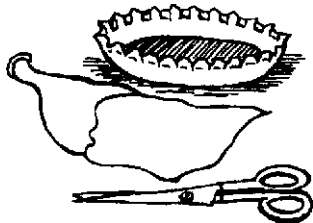
2. Take a toffee wrapper. Hold its short edge tightly between the thumbs and first fingers of both the hands.



3. Place the edge close to the mouth and blow hard. The edge will vibrate and give out a shrill whistle like sound.

### SODA CAP ORGAN

With a soda water bottle crown cap and a torn balloon, you can make a musical organ.



1. Take a soda water bottle crown cap. Take a piece of torn balloon.



2. Stretch a single layer of the balloon rubber on the cap. The serrations on the rim of the crown cap will hold the balloon in place.



3. The stretched balloon acts like a membrane in tension.

4. Now keep the cap close to your lips and blow at an angle. You will be able to hear loud and musical notes from this organ. With a little practice you will find out the correct angle of blowing the air.



(Pix: Avinash Deshpande)

### PAPER ALIVE

As soon as you cut a small strip of paper and place it on your hand, it begins to twist and turn as if it were alive!



1. You need a piece of cellophane paper - the kind used for packing sweet boxes. Cut a 1-cm x 4-cm strip and a flower with 4 petals with this gelatine paper.



2. Keep the strip on your hand. Soon the strip will begin to curl up. It will twist and turn as if paper had life in it! The four petals of the flower will curl up into a bud shape.

## SPECIAL OLYMPICS

This is a special story. We need more co-operation than competition.

Several years ago, something amazing happened at the Special Olympics in Seattle.

The race was the 100-meter dash and nine contestants, all with physical disabilities, stood ready at the starting line.

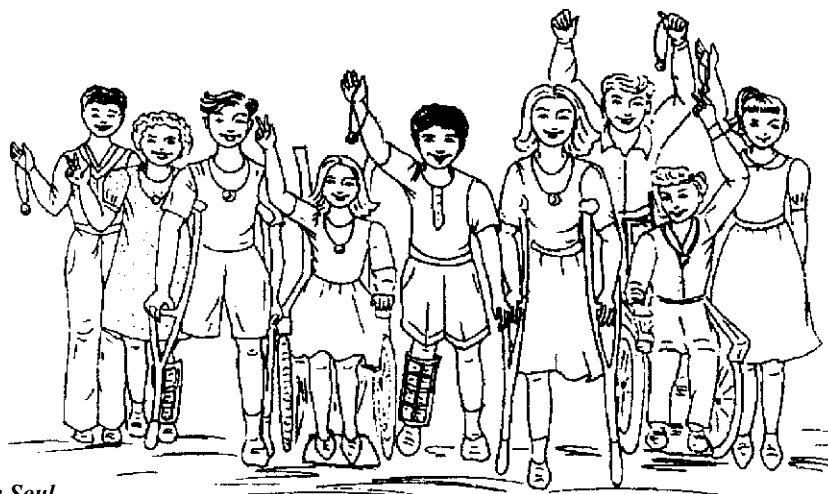
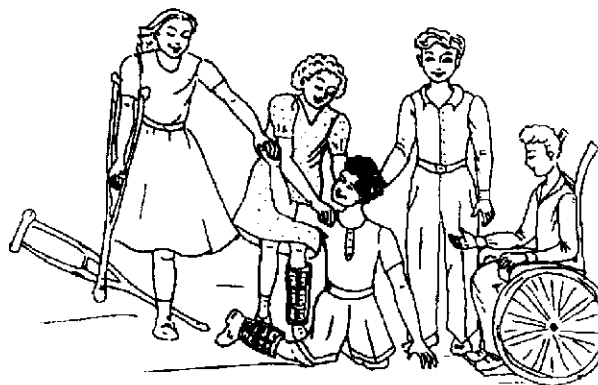
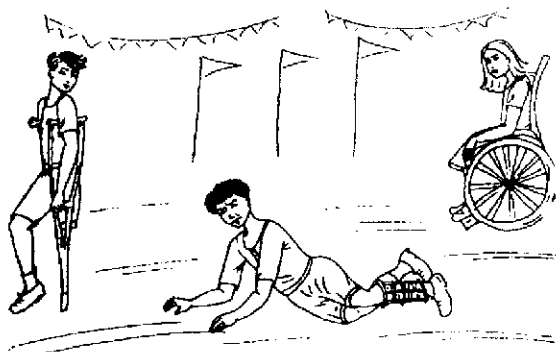
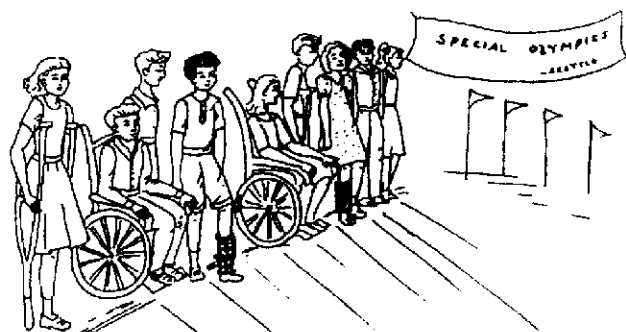
The gun fired and everyone took off, not exactly in a dash, but all eager to win. All, that is, except for a little boy who stumbled and tripped, then fell to the ground and began to cry.

Hearing him, the other contestants stopped running to see what had happened. Then one by one, they turned around and went back to help him up. Every single one of them.

When he was back on his feet, dusted off and tears dried one girl with Downs Syndrome had put her arms around him and kissed him gently, saying, 'This will make him better.'

Afterwards all nine children joined hands and they all walked together to the finish line. The audience watched spellbound in disbelief.

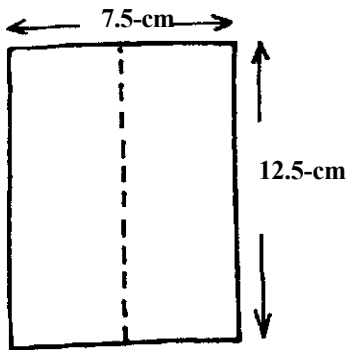
Nine gold medals were awarded in that race and the crowd that cheered the winners on with a standing ovation learned something about friendship that day that they would never forget.



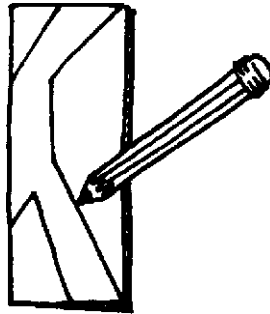
*Chicken Soup for the Soul*  
(Pix: Abha Mehrotra)

## BALANCING BOY

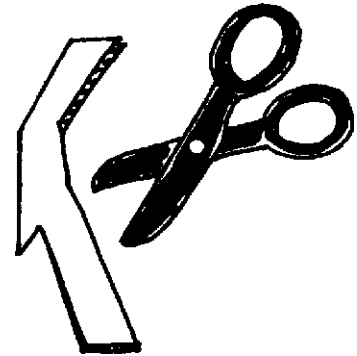
This is a fun toy. You could try lots of variation. Instead of the notch, put a small pulley.  
Then the Balancing Boy will not “walk” but “run” on the tightrope.



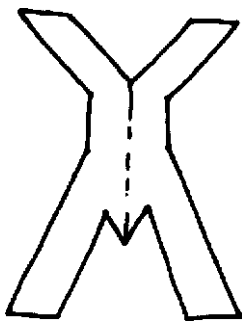
1. Fold a 7.5-cm x 12.5-cm thick card sheet in half along the length.



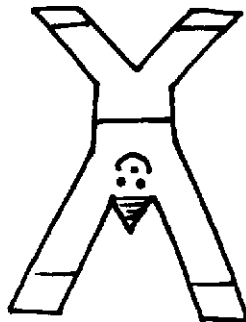
2. Draw the outline of the Balancing Boy on the folded card.



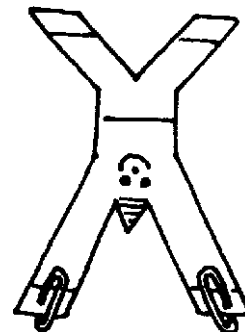
3. Cut the folded card. *(For good balancing the Balancing Boy must have very long arms.)*



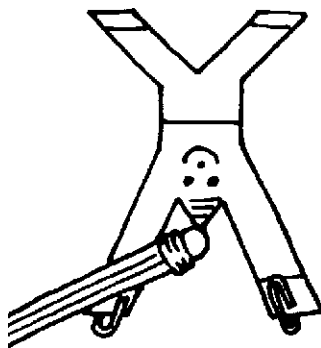
4. Open and flatten it. If you feel it is not stiff than stick on a cardboard.



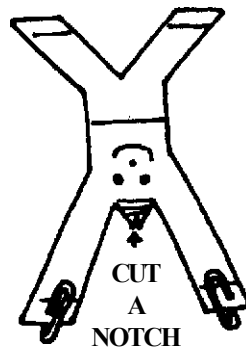
5. Now draw the face of the Balancing Boy and colour it.



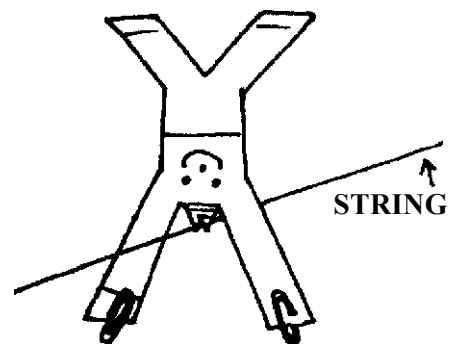
6. Attach a heavy paper clip to each arm. Actually sticking a coin on each hand is better.



7. Test the model by balancing it on a pencil eraser or your finger.



8. For balancing the model on “tightrope” you can cut a notch in the Balancing Boy’s Cap.



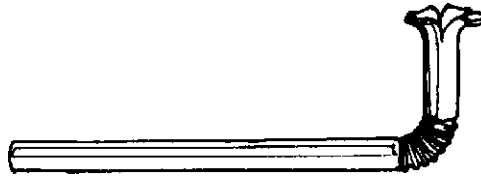
9. Now you can hold a “tightrope” between your two hands and make the Balancing Boy walk the rope. You can put a small pulley to make the Balancing Boy “run”.

## FLOATING BALL

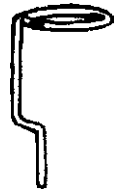
You can make a very simple Floating Ball toy with simple materials found at home. The floating ball could be carved from a piece of thermocole or just use a pea seed.



1. Take a flexible soda straw. Carefully cut the small end so that there are four small fingers of plastic sticking out as shown. Gently bend these pieces down to make a cradle for the pea or a thermocole ball.



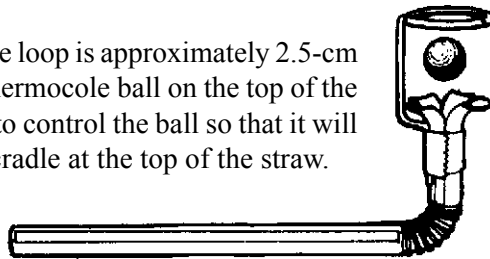
2. Bend the short end of the straw at right angles to the longer piece.



3. Bend a piece of thin wire as shown with a pliers.

4. Tape the wire loop to the top of the soda straw so that the loop is approximately 2.5-cm above the opening of the straw. Now place the pea or a thermocole ball on the top of the straw and blow gently. With practice you should be able to control the ball so that it will rise above the loop and settle back down again into the cradle at the top of the straw.

BLOW →



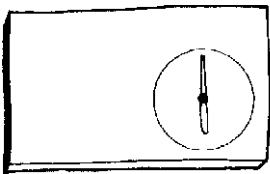
## FLIP-BOOK

In order to make this flip book you will need a small notebook, and a sketch pen.

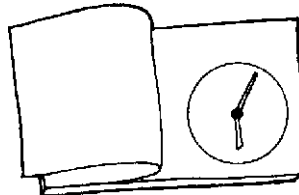
You must decide on a moving thing - a bouncing ball, a running horse or a moving clock.

The book consists of a series of sequential pictures put on separate sheets of paper, one after the other.

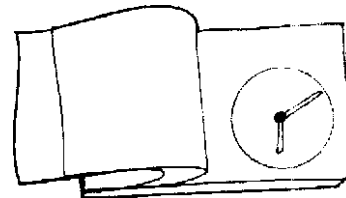
When the book is quickly flipped through, the pictures provide the illusion of a moving picture.



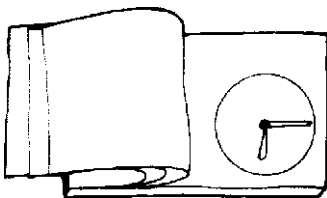
1. Draw a clock dial with its two hands on the first page.



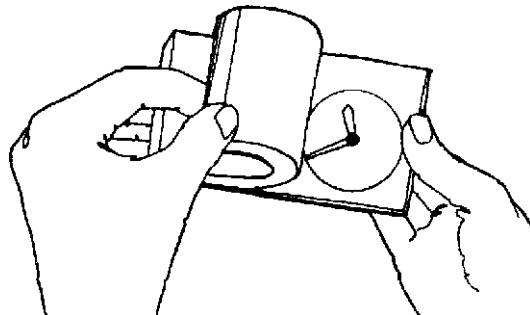
2. Rotate the minute's hand clockwise a little bit.



3. And a little more...



4. And a little more....

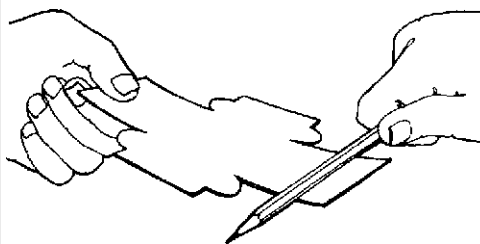
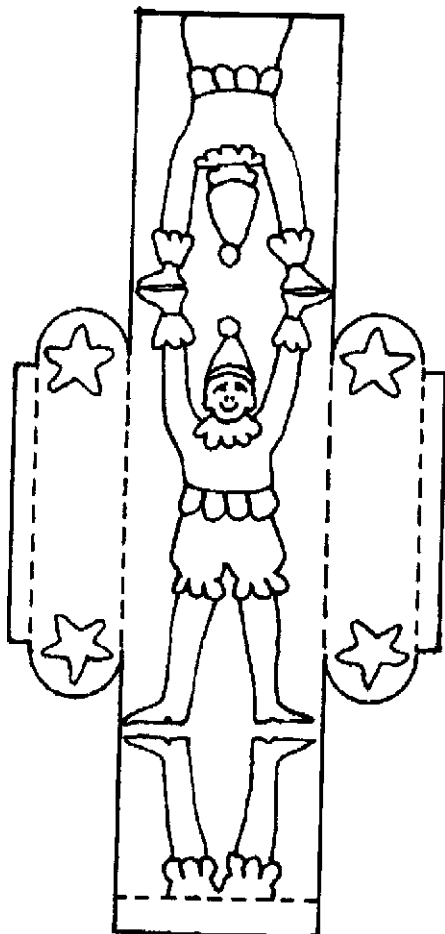


5. On flipping through the pages you will see the clock moving!

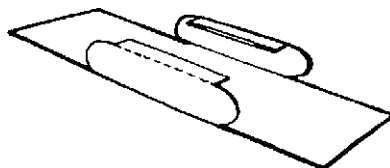
## TUMBLING ACROBAT

Earlier children used to make this toy using an empty medicine capsule and a bicycle ball bearing. This toy employs the force of gravity to move. It is simple and great fun.

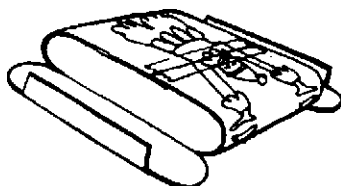
1. Copy the given pattern on a card sheet. Then cut the pattern.



2. Press the cut-out pattern on a table with a pencil. Pull the pattern a few times to make the paper flexible.



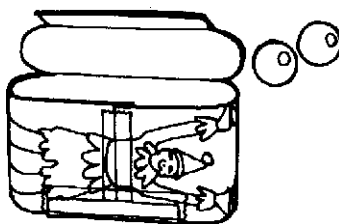
3. Fold the flaps on the pattern along the dotted lines.



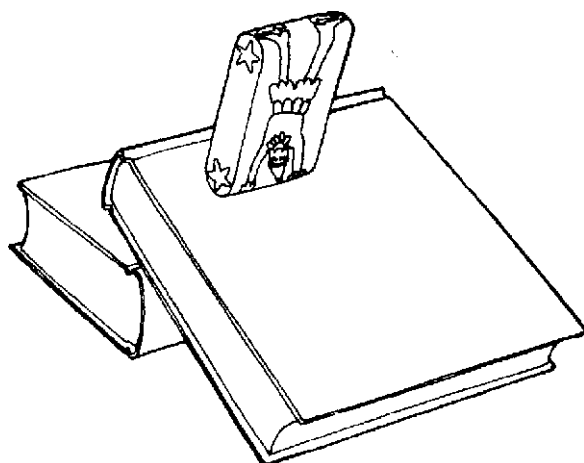
4. Now make a loop out of the pattern and tape the ends on the inside.



5. Tape one flap to the inside of the loop.



6. Place two marbles inside the loop and tape the other flap closed.

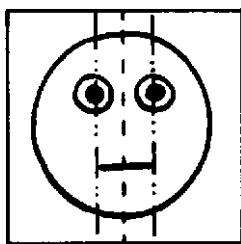


7. Now rest the Tumbling Acrobat on an inclined surface. The Acrobat will tumble down. If the Acrobat just slides down, it means that the surface is too smooth. Then you can try using a rougher surface.

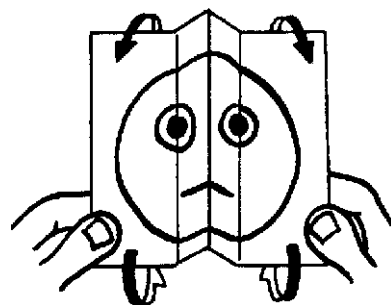
## HAPPY OR SAD



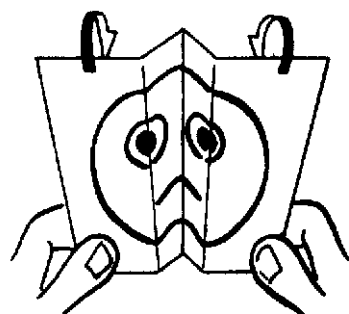
1. Draw a simple face on a piece of paper. It can be any sort of face. But the mouth must be a horizontal line.



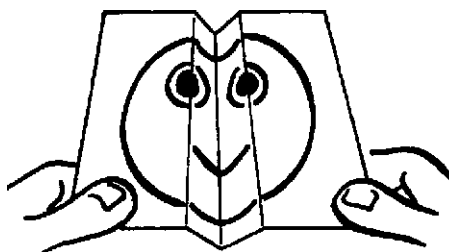
2. Put a mountain fold across each end of the mouth line and extend them to the top and bottom edges of the paper. Put a valley crease between them.



3. Hold the paper by the bottom corners and tilt the top edge towards you.



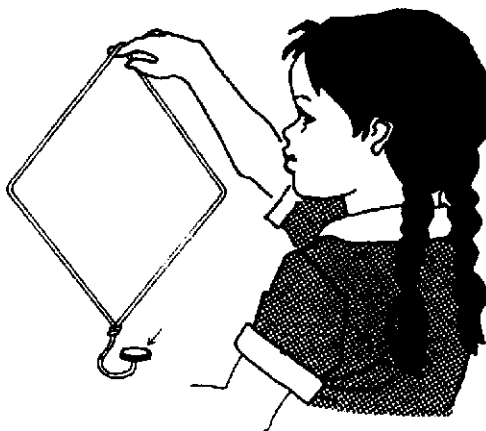
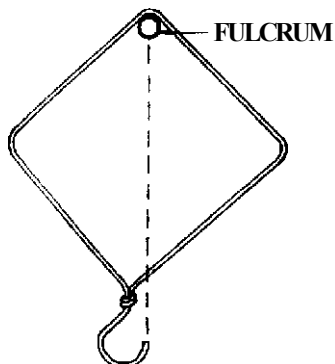
4. The face will look sad.



5. Tilt the bottom edge towards you and the face will look happy!

## FUNNY MONEY

Hold an aluminium hanger by the hook and midway along the longest side, stretch it into an elongated, diamond shape. Now bend the hook slightly so that it points back toward the opposite end of the diamond. File the end of the hook flat, so that a coin will balance on it. Dangle the hanger from your index finger and carefully balance a coin on the end of the as shown. The balancing is a bit tricky but this makes the demonstration all the more impressive. A little practice, a steady hand, and a lot of patience are all desirable at this point! Rock the hanger to-and-fro and then swing the hanger all the way around. If you are careful then the coin will remain “balanced” on the end of the hook even when you slow and stop the hanger. You can also rotate the hanger with the coin “balanced” around your head. Where is the coin? Is it still on the hanger?



(Pix: UNESCO)

## THE SCIENTIFIC METHOD OF PROBLEM SOLVING

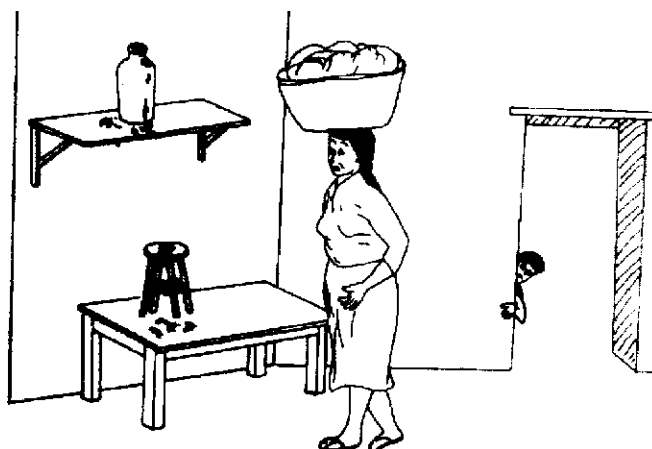
The scientific method can be explained using big words like hypothesis, theory, etc. But it might be more useful to look into a situation where these steps have actually been used.



One morning Mama prepares some *Jamun* (a purple fruit) jam, and then goes to the river to wash clothes. In the afternoon Mama comes back from the river. She sees that someone has eaten the jam and left behind a big mess.

What is her first idea about how this happened? That one of her children stole the jam. How can she find out which of her 5 children did it? She could call all the children and ask them? But what if they don't tell? She could find out what the children were doing when she was at the river.

Maybe some were away so she can be sure that they didn't steal the jam. One boy was away getting firewood and had the wood to prove it. One daughter was at the grandmother's house. So how many culprits remain? Just three. Why doesn't she look at their hands and mouths? *Jamun* jam leaves a purple stain. Good, suppose she finds that all three of them have purple stains on their fingers and tongues. Then what? Punish all three! But suppose each one says he didn't steal the jam; that another gave it to him.



How can Mama be sure which one actually stole it? Maybe the one who stole left a 'handprint' in the kitchen, so she can tell which one it was. But what if the children's hands were all about the same size? Then what? Some detectives take 'fingerprints'. Maybe she could take their fingerprints with ink. Then she could be sure who stole the jam. What should Mama do next? Counsel the culprit! And after counseling how can she tell if she was right about who did it, and if the counseling was effective.

By seeing whether any more jam is stolen!

Now let us look at the various steps Mama took to find out about the jam thief. The steps will be something like this:

1. Mama becomes aware of the problem.
2. She is certain about how it happened.
3. She guesses that one of her children is responsible.
4. She notices the details or 'evidence'.
5. She asks questions.
6. She examines her children's fingers.
7. She considers all possibilities.
8. She conducts tests to prove or disprove the different possibilities.
9. She decides who is probably guilty.
10. She provides punishment.
11. She sees whether the results were effective.
12. She starts over again with step 1 if the results were not effective.

**THIS IS THE SCIENTIFIC METHOD**

(HELPING HEALTH WORKERS LEARN by David Werner and Bill Bower)

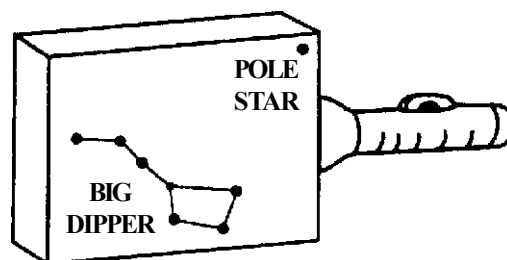


## MINI PLANETARIUMS

You can make some working models that show the positions and apparent motion of the stars much like a real planetarium.

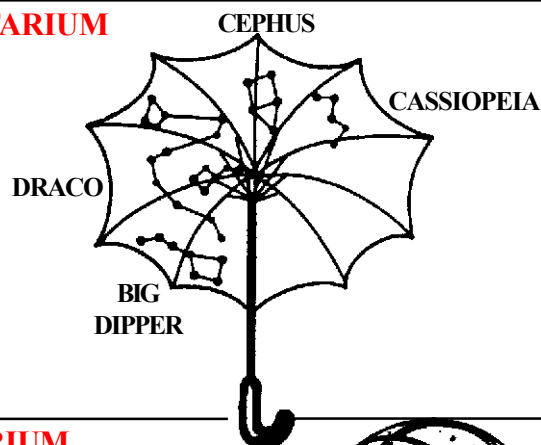
### CARDBOARD BOX PLANETARIUM

Collect a few thin cardboard boxes. Each box can be used to show a different constellation. Mark out the pattern of the constellation on the box and then punch holes in the wall. Make a small opening on the side of the box for a torch. Take the box in a dark room. Shine the torch in the box to make the constellation glow!



### UMBRELLA PLANETARIUM

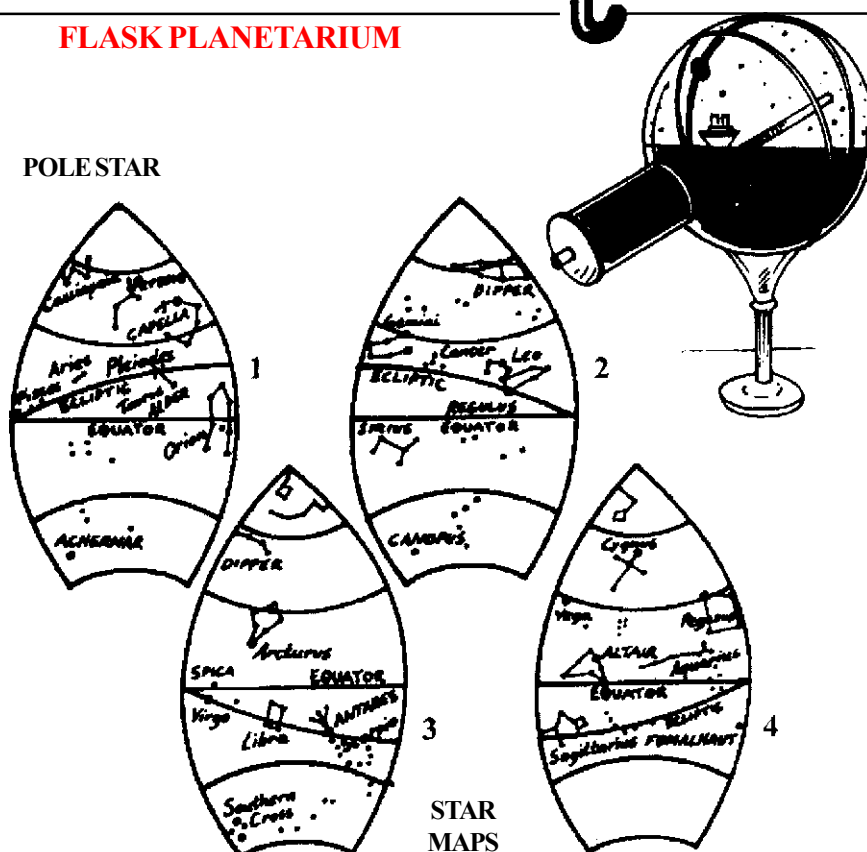
Use chalk or markers to draw star patterns on an umbrella. You can even cut out stars and stick them on the umbrella. Put the Pole Star along the stick of the umbrella. The Pole Star is at end of the handle of the Little Dipper (*Saptarishi Mandal*). Mark the positions of some other constellations like the Big Dipper, Draco, Cassiopeia and draw lines to connect the stars. Turn the umbrella counter clockwise to see how the stars appear to move through the night sky.



### FLASK PLANETARIUM

You can make a nice planetarium using a round bottom chemist's flask. You can enjoy the rising and setting of constellations below the horizon of the blue sea. The picture is self-explanatory. Fill the flask midway with a blue liquid to represent the ocean. Plug the mouth of the flask with a stopper. Now place a rubber band around the middle of the flask for the equator. Place another rubber band at 23-degrees (use a protractor) to the equator to depict the ecliptic – the path of planets, moon and the sun.

Use tape to divide the distance between the equator and the poles into 3 equal parts. Each third stands for 30-degrees. Now transfer the quarter-sphere maps below onto the surface of the flask with a glass marker.

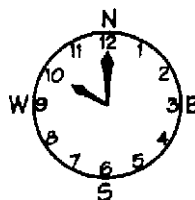


(SCIENCE IS by Susan Bosak)

## STARRY STARRY NIGHT

How do you describe the position of a star or tell distances between stars?  
Here are some simple ways of doing it.

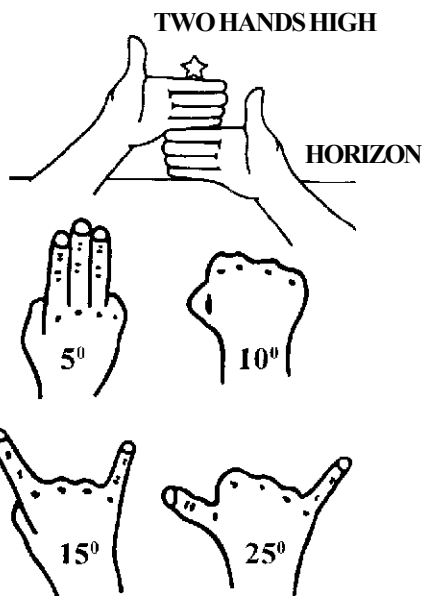
To indicate the direction of a star you can simply say look 'east' or 'north-east'. But this is not very accurate. You can do better by imagining you are facing a big clock and the number 12.00 is north. You can now indicate the position of a star by saying, "Look for the star at 5.00 O'clock position."



To find the star's altitude look at the point on the sky directly over your head – the 'zenith'. For this you will either have to lie down or lean your as far back as possible. All luminous objects in the night sky are found between the horizon (0 degrees) and the zenith (90-degrees). If a star is midway - between the horizon and zenith, than it is at 45-degrees.

You can find a star's altitude with the help of your hands. Hold one hand an arm's distance from you in the position shown. Bring your hand down to meet the horizon. Then the top of your index finger will be 'one hand high'. A star could be two hands plus three fingers high. To point out a star, combine the imaginary clock and the divisions of 90-degrees. For example if you see a star in the north direction about halfway between the zenith and the horizon than you could say, "The star is at 3.00, 45-degrees."

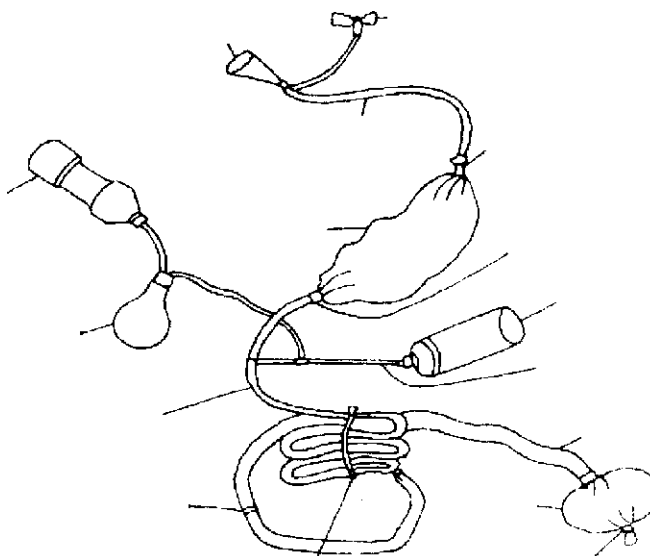
You could find the apparent distance between stars in degrees with the help of your hands and fingers. For this is one measuring instrument, which you are unlikely to forget! The width of the tip of your little finger is about 1-degree. Some others hand / finger measures are shown. The Big Dipper is a good way to test this measuring system. The distance between the two pointer stars in the Big Dipper is 5-degrees (three middle fingers). The distance across the top of the bowl is 10-degrees (one fist).



## MODEL OF DIGESTIVE SYSTEM

You can make a model of the digestive system using everyday common objects like:

Plastic Bottle - *Liver, Pancreas*  
Used Light Bulb - *Gall Bladder*  
Tape or String - *Cardiac Sphincter*  
Funnel - *Mouth*  
Sweet Paper - *Salivary Glands*  
Thin Plastic Tube - *Ducts*  
Bicycle Inner Tube - *Large Intestine*  
Plastic Bag - *Rectum*  
Rubber Tube - *Duodenum, Small Intestine, Oesophagus*

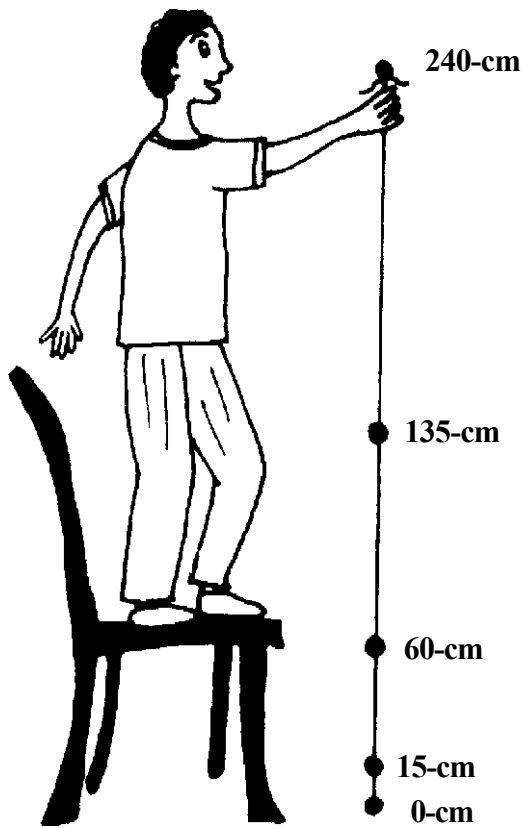


(VSO SCIENCE TEACHERS HANDBOOK)

## DROPPING A STRING OF MARBLES

Our ears are very sensitive to the beat of music. An experiment on the acceleration due to gravity “g” can be easily performed using this ability. For doing this experiment you will need 5 marbles, a piece of string and some sticky tape. The string should be as high as the room. So take a 3-meters long string. The marbles are taped to the string in relative proportions to the square of the whole numbers i.e.

Number	0	1	2	3	4
Square	0	1	4	9	16
Distance	0	15-cm	60-cm	135-cm	240-cm
Difference		15-cm	45-cm	75-cm	105-cm



(Pix: Dulari Gupta)

Now, stand on a chair holding the string as shown. The bottom marble should not quite touch the floor. Drop the string, and listen to the clicks. The clicks are more audible if the string is dropped on a metal plate - a “thali”.

You can repeat the experiment with a string having marbles spaced at uniform 60-cm intervals. Do you hear the time between clicks get shorter as the higher marbles from this last string strike the floor? Qualitatively the higher marbles have been accelerated for a longer time, and so they are travelling faster, covering the same distance in a shorter time as they approach the floor than do the marbles starting near the floor.

Quantitatively we have the familiar formula

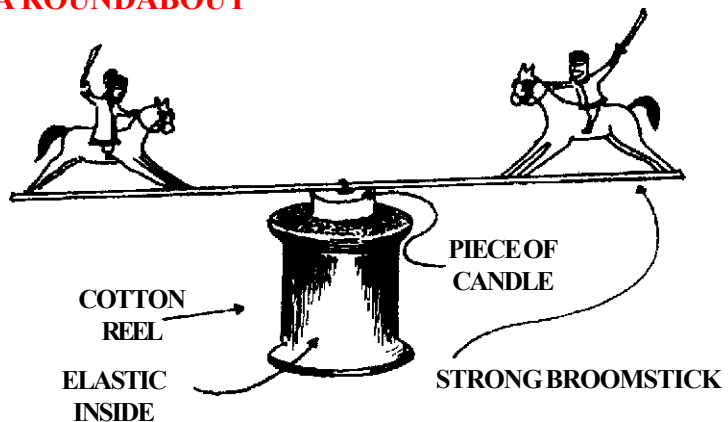
$$\text{Distance} = 0.5 g (\text{time})^2$$

We spaced the marbles on the non-uniform string so the square roots of successive distances are proportional to the whole numbers. The time taken between successive clicks should then be constant, about 0.176 seconds. Shift one of the marbles up or down the string to test the sensitivity of your ear to the time between clicks. A change of 20% is easily detectable.

## A ROUNDABOUT

This roundabout is just like the reel tractor shown earlier. Once you wind up the rubber band it will keep rotating on its own for a little while.

THICK  
PAPER  
FIGURE



(Pix: David Horsburgh)

### THREE DAYS TO SEE

What would you look at if you had just three days of sight? Helen Keller, blind and deaf from infancy, gives her answer in this remarkable essay.

I have often thought it would be a blessing if each human being were stricken blind and deaf for a few days at some time during his early adult life. Darkness would make him more appreciative of sight, silence would teach him the joys of sound.

Now and then I have tested my seeing friends to discover what they see. Recently I asked a friend, who had just returned from a long walk in the woods, what she had observed. "Nothing in particular," she replied.

How was it possible, I asked myself, to walk for an hour through the woods and see nothing worthy of note? I who cannot see find hundreds of things to interest me through mere touch. I feel the delicate symmetry of a leaf. I pass my hands lovingly about the smooth skin of a silver birch, or the rough, shaggy bark of a pine. In spring I touch the branches of trees hopefully in search of a bud, the first sign of awakening Nature after the winter's sleep. Occasionally, if I am very fortunate, I place my hand gently on a small tree and feel the happy quiver of a bird in full song.

At time my heart cries out with longing to see all these things. If I can get so much pleasure from mere touch, how much more beauty must be revealed by sight. And I have imagined what I should most like to see if I were given the use of my eyes, say for just three days.

On the first day, I should want to see the people whose kindness and companionship have made my life worth living. I do not know what it is to see into the heart of a friend through that "window of the soul," the eye. I can only "see" through my fingertips the outline of a face. I can detect laughter, sorrow, and many other obvious emotions. I know my friends from the feel of their faces.

For instance, can you describe accurately the faces of five different friends? As an experiment, I have questioned husbands about the colour of their wives' eyes, and often they express embarrassed confusion and admit that they do not know. I should like to see the books which have been read to me, and which have revealed to me the deepest channels of human life. In the afternoon I should take a long walk in the woods and intoxicate my eyes on the beauties of the world of Nature. And I should pray for the glory of a colourful sunset. That night, I should not be able to sleep.

On my second day, I should like to see the pageant of man's progress, and I should go to the museums. I should try to probe into the soul of man through his art. The things I knew through touch I should now see. The evening of my second day I should spend at a theatre or at the movies. The following morning, I should again greet the dawn, anxious to discover new delights, new revelations of beauty.

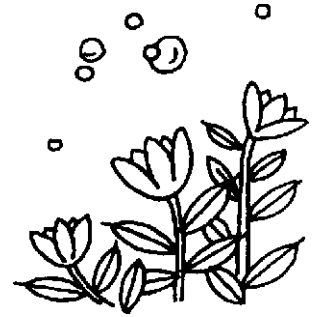
Today this third day, I shall spend in the workday world, amid the haunts of men going about the business of life.

At midnight permanent night would close on me again. Only when darkness has descended upon me should I realize how much I had left unseen.

I am sure if you faced the fate of blindness you would use your eyes as never before. Everything you saw will become dear to you. Your eyes will touch and embrace every object that came within your range of vision. Then, at least, you would really see, and a new world of beauty would open itself before you.

I who am blind can give one hint to those who see: Use your eyes as if tomorrow you would be stricken blind. And the same method can be applied to the other senses. Hear the music of voices, the song of a bird, the mighty strains of an orchestra, as if you would be stricken deaf tomorrow. Touch each object as if tomorrow your tactile sense would fail. Smell the perfume of flowers, taste with relish each morsel, as if tomorrow you could never smell and taste again. Make the most of every sense; glory in all the facets of pleasure and beauty, which the world reveals to you through the several means of contact which nature provides.

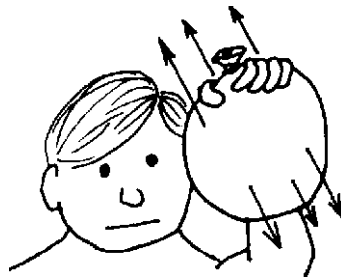
But of all the senses, I am sure that sight must be the most delightful.



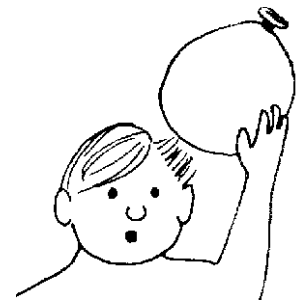
## STATIC ELECTRICITY



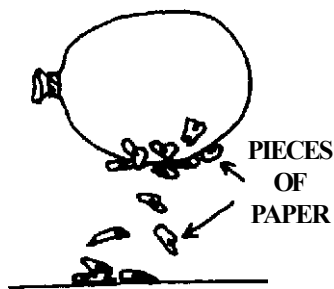
1. Blow up a balloon and tie its knot.



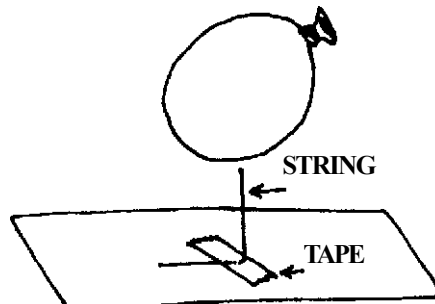
2. Rub the balloon against your hair several times. This will give the balloon an electric charge.



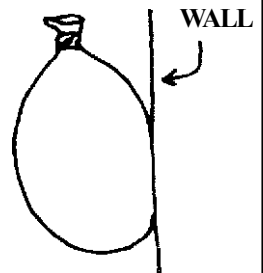
3. If you hold the charged balloon over your head, your hair will stand on edge.



4. Tear small pieces of newspaper. Bring the charged balloon near them. The bits of paper will stick to the balloon.



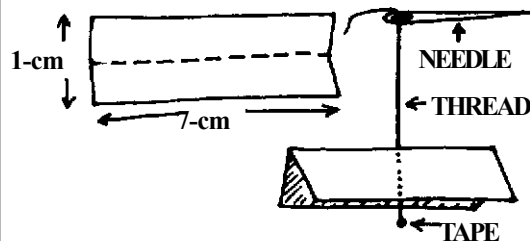
5. Tape a thread to the table. Raise the thread with the help of the charged balloon.



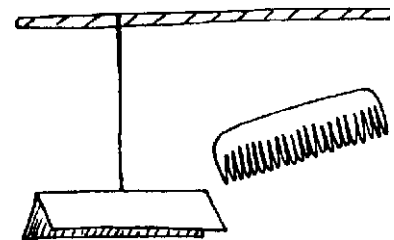
6. You can easily stick a charged balloon to the wall.



7. Try to charge a plastic comb by combing your hair.



8. Fold a rectangle of paper and hang it from a thread.



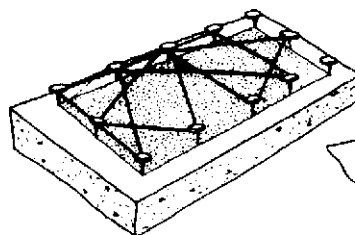
9. What happens when you bring the charged comb near the paper?

## NAIL BOARD

Hammer a few nails on a wooden board to form a grid.

Ask children to make different shapes by stretching rubber bands on the nails.

Encourage children to make their own designs.

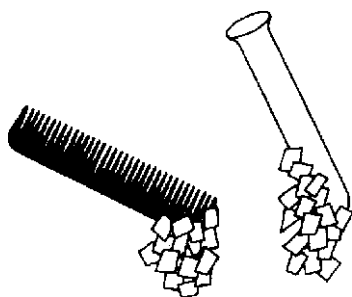


(Pix: Aga Khan Foundation)

## STATIC ELECTRICITY

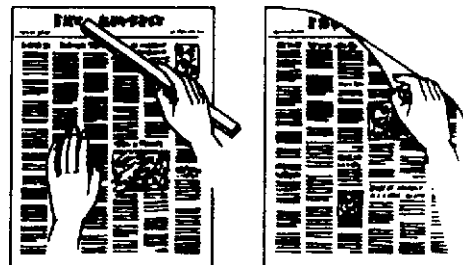
All these experiments work best when the air is dry.

### ELECTRICITY BY RUBBING



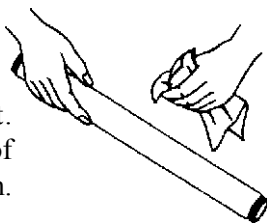
Rub a plastic comb, pen, a piece of wax, a rubber balloon, a glass dish - any non-metallic object briskly with your hair or with wool and bring them near the pile of paper pieces. Observe what happens.

### NEWSPAPER STAYS ON THE WALL



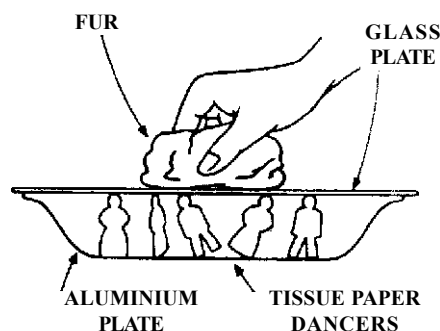
Press an old newspaper smoothly against a wall. Stroke the newspaper with a pencil all over its surface several times. Pull up one corner of the paper and then let it go. Notice how it is attracted back to the wall. If the air is very dry, you may be able to hear the crackle of the static charge.

### FUSED TUBELIGHT GLOWS



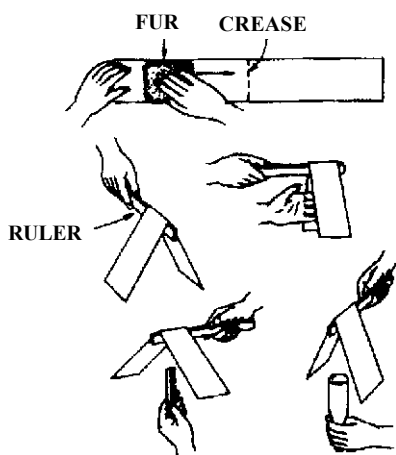
Take a fused tube light. Rub it briskly with a piece of fur or flannel in a dark room. What do you observe?

### DANCING DOLLS



Take an aluminium foil plate about 2.5-cm deep and cover it with a glass plate. Cut some little doll figures from thin tissue paper as shown in the drawing. The figures should be a shorter than the depth of the plate. On rubbing the glass plate with fur you can make the figures dance.

### NEWSPAPER ELECTROSCOPE



Cut a strip of newspaper 60-cm long and 10-cm wide. Crease it in the centre and hang it over a ruler as shown. Hold the strip on the table and stroke it several times with a piece of fur or flannel. Lift it from the table with the ruler and observe how it acts. Bring other charged objects between the extended leaves of the newspaper, and notice the change.

### STATIC ELECTRICITY EVERYWHERE

Hold two strips of newspaper about 5-cm wide and 30-cm long, together. Stroke them lengthwise with the thumb and finger of your free hand. What happens? Try and devise other experiments showing that there is static electricity everywhere.

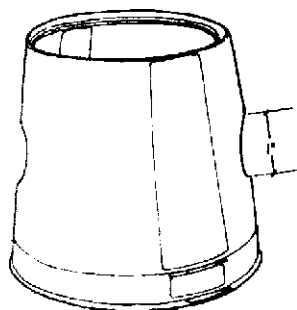


( 700 SCIENCE EXPERIMENTS FOR EVERYONE - UNESCO )

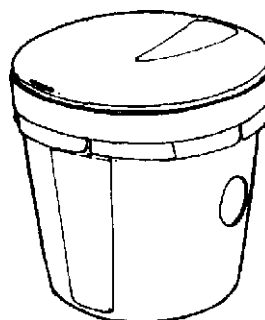


## SIMPLE MICROSCOPES

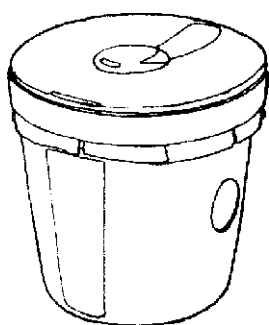
Here are two different ways of making a simple microscope.



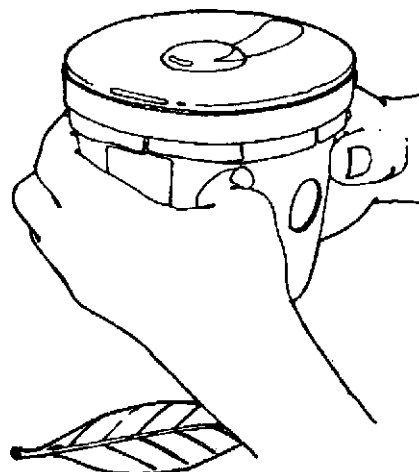
1. Take an ice cream, or thermocole cup. Cut out its bottom. Then cut two holes 2.5-cm in diameter, opposite each other to let in the light.



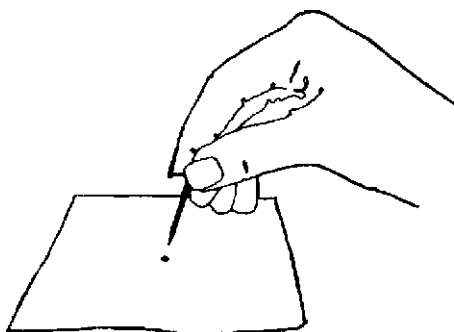
2. Cover the top of this container loosely with a piece of plastic. With a rubber band keep the plastic in place.



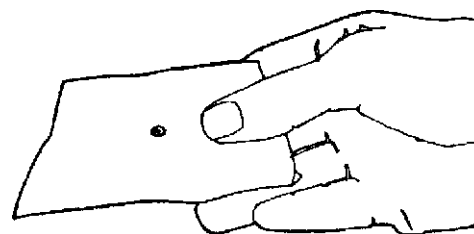
3. Slowly pour a small amount of water, onto the plastic. The weight of the water will make the plastic sag, causing it to take the form of a lens.



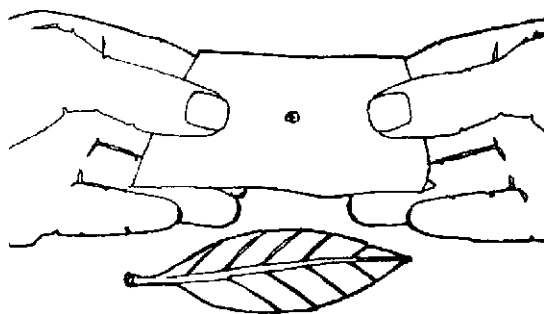
4. Put various objects underneath the water lens. Experiment with different amounts of water, which will change the shape of the lens and make it work more effectively.



5. Another simple microscope can be made by a small hole through a piece of aluminium foil with a pin.



6. Drop a very small amount of water into the hole. Surface tension will keep the water from falling through the hole.

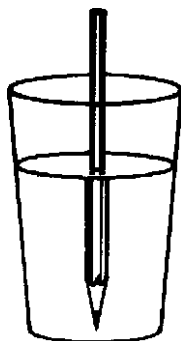


7. Place an object underneath the lens and examine it. With this microscope it is possible to get a magnification of 150 times the size of the object!



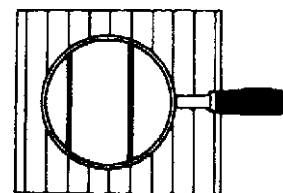
### HOW LENSES MAGNIFY

Dip a pencil or your finger into a glass of water, and look at it from the side. Is it magnified? Clear glass marbles act as lenses too.

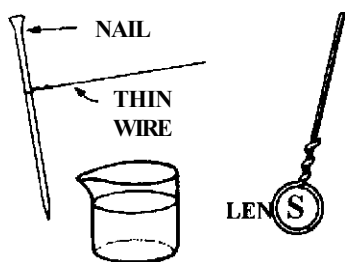


### MEASURING MAGNIFYING POWER

Focus a hand lens over some lined paper. Compare the number of spaces seen outside the lens with a single-space seen through the lens. The lens shown in the diagram magnifies three times.



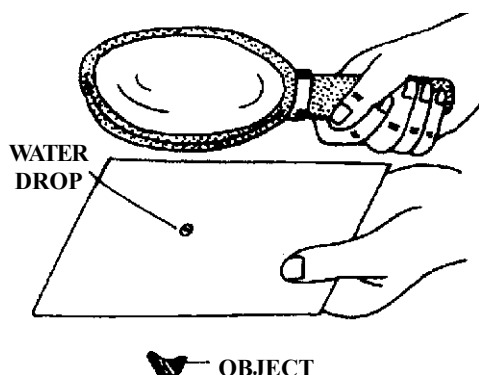
### WATER DROP MICROSCOPE



Make a single turn of copper wire around a nail to form a loop. Dip the loop into water and look through it. You will have a primitive microscope. Often such a lens will magnify 4-5 times. If you tap the wire sharply against the edge of the glass a drop of water will fall off. Because of adhesion between the wire and the water, the liquid remaining will form a lens, which is very thin at the centre, i.e. a concave lens.

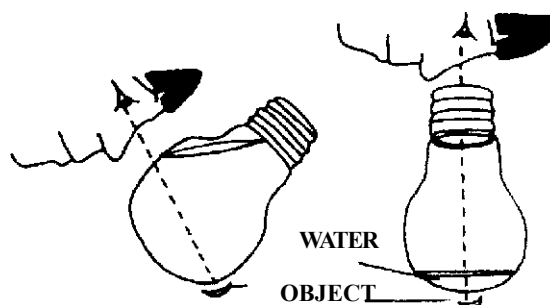
### SIMPLE COMPOUND MICROSCOPE

Using two lenses together allows much greater magnification. Use a hand lens to make a water drop into a more powerful magnifier.



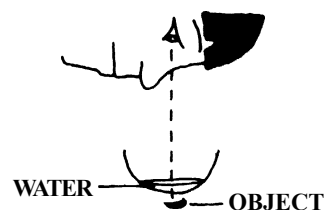
### EMPTY LIGHT BULBS

Varying the amount of water in the bulb alters the magnification.



### CURVED GLASSES

Putting water into curved glasses alters the magnification. Experiment with different depths of water.



### CLEAR CONTAINER MAGNIFIERS

Any of these containers filled with water will make good magnifiers.

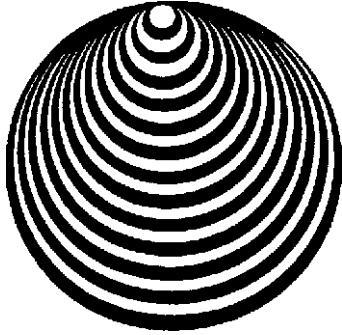
A clear marble magnifies.



(VSO SCIENCE TEACHER'S HANDBOOK)

## OPTICAL ILLUSIONS

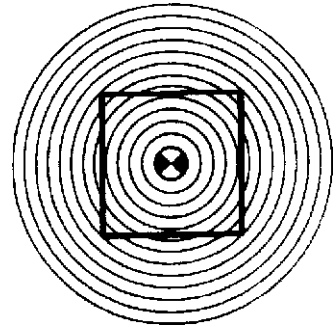
What on earth is an optical illusion? It is something you see that is not exactly what it appears to be. Some of the pictures at first glance appear “normal”, but look again and you will see something surprising! Sometimes we seem to look, but still don’t see!



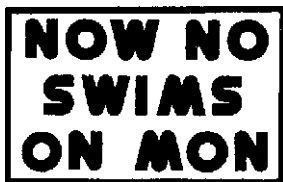
1. Are you looking at - the inside of a tunnel - or the top of a mountain.



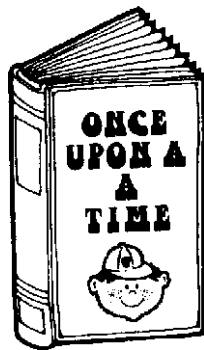
2. What you see is the pig, but where is the farmer?



3. What’s wrong with the square?



4. What is unusual about this sentence.



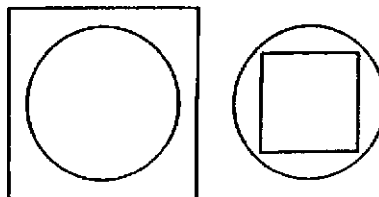
5. What’s the title of this book? Are you sure?



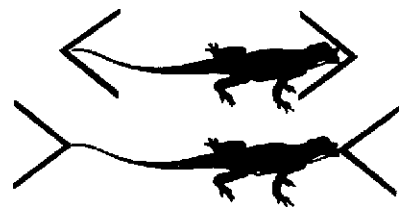
6. The man looks unhappy because his wife left him. But where is the wife?



7. Can you turn the duck into a rabbit?



8. Which circle is bigger?



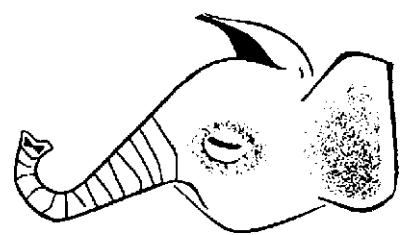
9. Which lizard is longer?



10. How many prongs are there on this fork - 2 or 3?



11. Can you help this boy take his medicine?



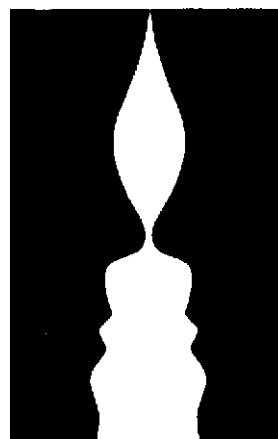
12. Appu the elephant is sad. Can you cheer him up?



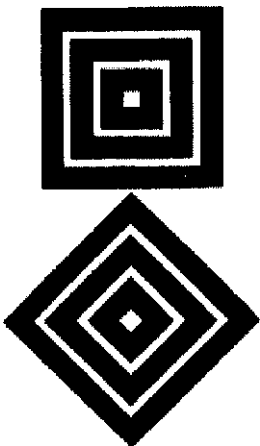
13. The magician has lost his rabbit. Can you find it?



14. What happens if you turn this wavy design upside down?



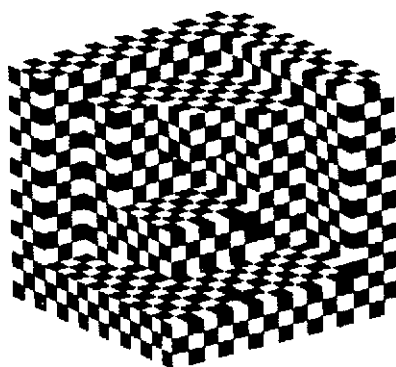
15. Do you see a candle or two faces?



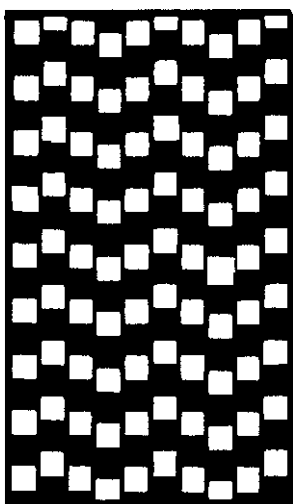
16. Which of the two squares is bigger?



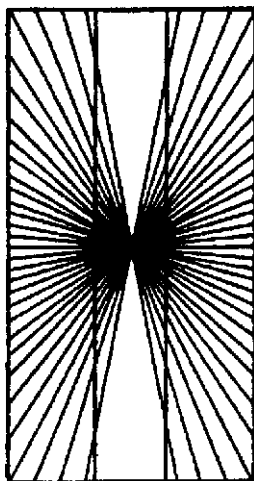
17. You see the horse, but where is the farmer?



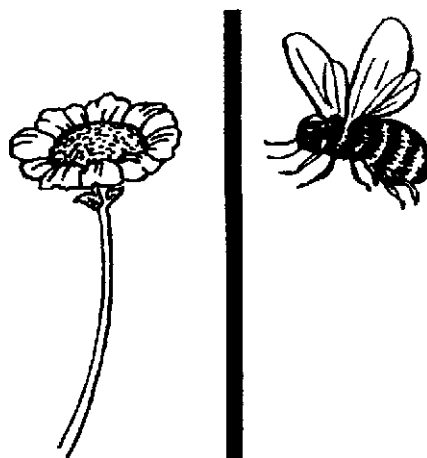
18. This cube is strange. What is wrong with it?



19. These black and white tiles look uneven. Are they in a straight line?



20. Are the two vertical lines parallel?



21. How can you get the bee closer to the flower?

**danger : *SCHOOL!***

**“Do not let schools interfere with your education.” Mark Twain.**

**danger: School!** is a landmark book. Paulo Freire was a Brazilian educator. For years he taught unschooled adult peasants to read and write in remote and poor villages. His method was a politically radical, grown up version of the method Sylvia Ashton Warner described in her book *Teacher*. Sylvia, who taught Maori children in New Zealand for 24 years, realised the incongruity of teaching language by using English primers that had little respect for, or reference to their lives. She devised an ingenious method – every day she asked children for an “emotive” word – a word about which children wanted to learn. If they said “drink” (as many children had alcoholic fathers) that word would be up on the blackboard and etched forever in the children’s minds.

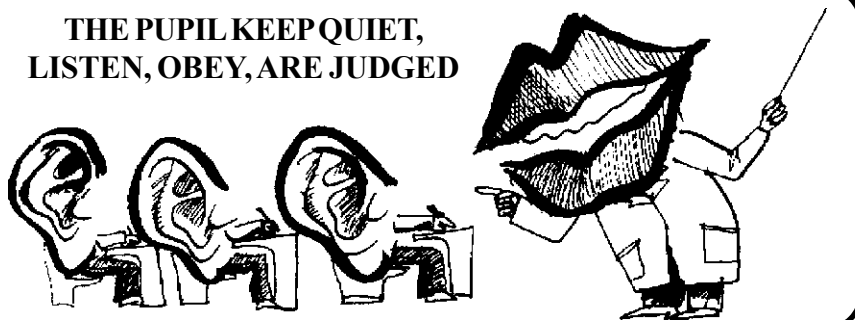
Following a similar method, Freire began by talking with Brazilian peasants about the conditions and problems of their lives, and showed them how to read and write those words which were most important for them. He found that it took only about 30 hours before the wretchedly poor and demoralised peasants were able to explore reading on their own.

Thirty hours! One school week! That is the true size of the task. Of course, the Brazilian army did not like Freire making peasants literate and politically conscious and threw him out of the country.

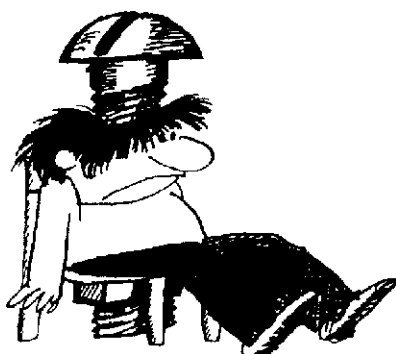
How many hours, weeks, months, years do our children spend in schools without even learning the basics? By nature children are inventive and full of curiosity. All children have a ‘gleam in their eye’ before they go to school. But soon this gargantuan Educocracy (education + bureaucracy) fails them, calls them impaired and stamps an indelible scar on their hearts. Many parents have always felt that there was something seriously wrong with schools. But they have never been able to pinpoint the ‘crimes’ which schools constantly perpetuate.

**danger: School!** does that. It is perhaps the world’s most subversive cartoon book on education. Drawn by Brazil’s ace political cartoonist Claudius, the scathing illustrations and crisp text graphically document the authoritarian, artificial world of the school.

**THE PUPIL KEEP QUIET,  
LISTEN, OBEY, ARE JUDGED**



**A WORLD OF SILENCE  
OF IMMOBILITY**



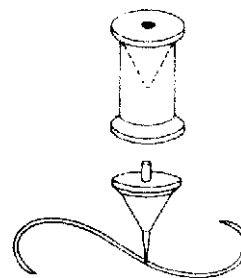
**danger: School!** is published by Other India Press, Mapusa, Goa 403507.

The entire book can be freely downloaded from <http://vidyaonline.net>

### A MAGNETIC SPINNER

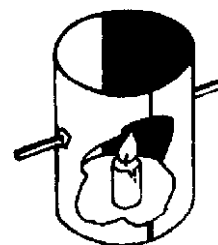
Make a spinning top from a wooden thread spool. Cut the spool in half and then shape one half into a cone. Find a nail to fit tightly into the hole of the spool. Cut off a length that will go through the cone and stick about 1-cm above the top. Grind the end, which juts out to a point. Magnetise the nail and insert it in the wooden cone. Form a large S-curve from a piece of soft iron wire. Place it on a smooth surface. If you set the top spinning near the curve it will follow the wire to the end.

(700 SCIENCE EXPERIMENTS FOR EVERYONE - UNESCO)



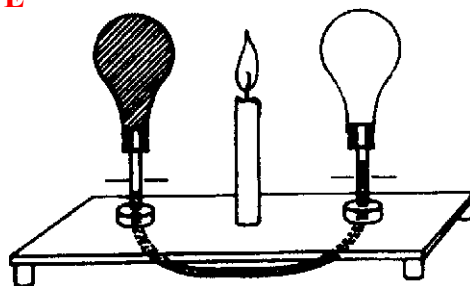
### BLACK HOT, WHITE COLD

Cut two vertical slits opposite each other on the side of a cylindrical tin, so that the surface of the tin is divided into two parts. Blacken the inside of one half leaving the other half shiny. Put a lighted candle inside the tin, in the exact centre of the base. A difference in temperature of the two surfaces can be detected with the fingers. Matchsticks fastened to the outside with wax can also be used as indicators. The one behind the black surface will fall off first.



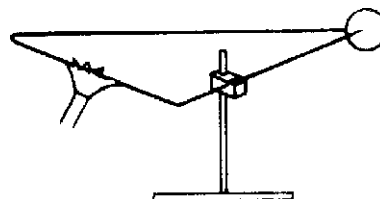
### SIMPLE THERMOSCOPE

Fit two empty electric bulbs with corks and 15-cm long tubes. Fix the bulbs in a vertical position on a board so that they are 22-cm apart. Connect the end tubes of the bulbs with rubber tubing. Now blacken one bulb in a candle flame. Pour water into the U tube so formed until the level is about 8-cm above the board. Slide the tubes to make the water level the same in both vertical tubes. Place a lighted candle equidistant between the bulbs and wait for results.



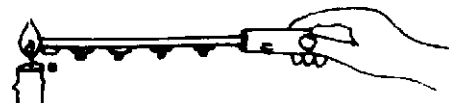
### TRIANGLE TO SHOW EXPANSION OF HEAT

Bend a piece of stiff metal wire into a triangle. Support it in the horizontal plane and suspend a coin between the two free ends forming one corner. Heat the opposite side of the triangle and the coin will fall off.

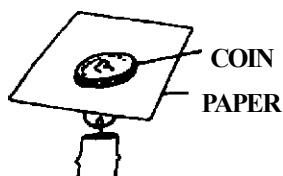


### HEAT CONDUCTION

Use candle wax to stick small stones or shoe-tack nails onto the metal rod at regular intervals. Put a cloth or handle around one end of the rod. When the rod is held in the flame the stones or nails will drop off as that part of the rod gets hot.

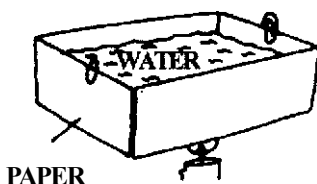


### NON-BURNING PAPER



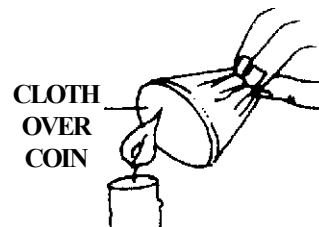
A coin on a conducting piece of paper conducts away heat before the paper burns.

### PAPER PAN



The paper pan will never burn as the temperature of the paper will never rise above 100° C.

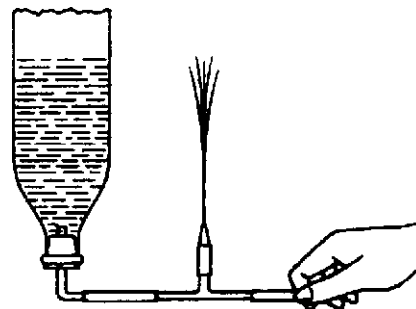
### FIRE PROOF CLOTH



Wrap a coin tightly in a cotton cloth and bring it near a flame. A coin conducts heat away before the cloth can burn.

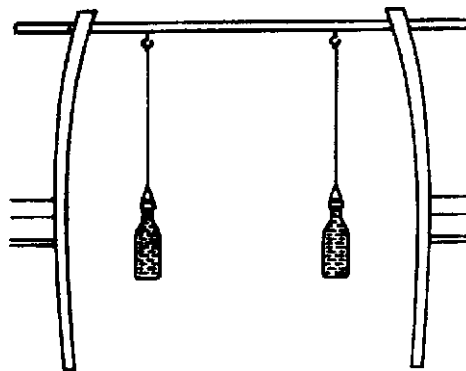
## MODEL HYDRAULIC RAM

Hydraulic rams are sometimes used to raise water in hilly areas from a low level to a higher level. A flowing stream of water operates them. You can make a model hydraulic ram using a plastic water bottle (with the bottom removed). Rig up the arrangement as shown. Fill the bottle with water and allow water to flow through the extreme right hand rubber tube. Stop the flow by quickly pinching the tube and note the height to which the water squirts from the jet tube. Let the water flow and stop alternately, and you have a working model of the hydraulic ram.



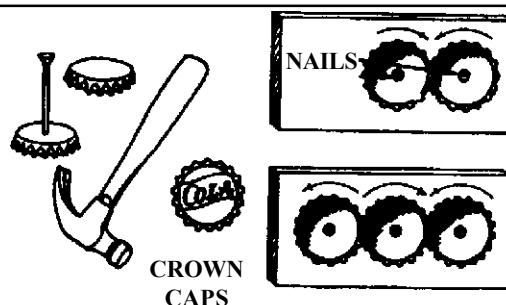
## SHIFTING PENDULUMS

Fill two similar bottles with water and tighten the lids. Place a wooden rod across the back of two chairs. Suspend the bottles as pendulums from the rod. Make sure that they are the same length. Hold one pendulum and start the other swinging; then release the other one so that it hangs at its zero point. Soon the swinging pendulum will slow down, and the one that was quiet will take up the swing.



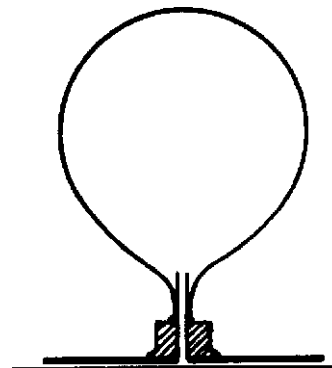
## SIMPLE GEARS

With a nail and a hammer, make holes in the centres of a few bottle crown caps. Lay two caps on a block of wood so that the tooth-like projections mesh together. Fasten them down with nails, but make sure that they still turn easily. Turn one of the caps and note the direction that the other turns. Add a third cap and note the direction that each turns.



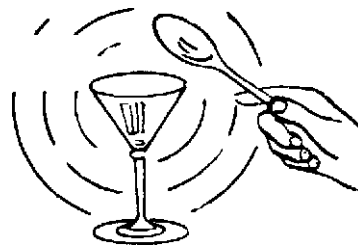
## SIMPLE HOVERCRAFT

You can use an old CD to make this simple hovercraft. Stick a cardboard disk to cover the hole of the CD. With a pin, make a small hole through the centre of the cardboard. Stick a small cotton reel in the centre of the CD. Find a tube, which just fits, into the centre of the reel. Push this tube into the neck of a balloon and secure it in place with a rubber band. Blow up the balloon, pinch the neck, and insert the tube into the hole in the cotton reel. Place the CD on a table and release the air. The expanding air, escaping through the hole in the disc, will cushion the card, so that, given a flick, it will shoot across the table with practically no friction.

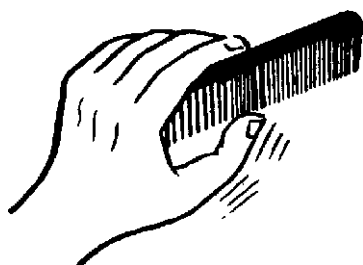


## SOUND

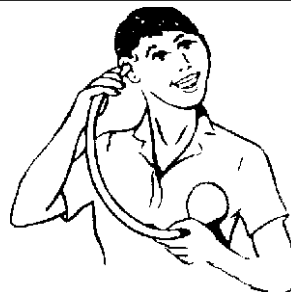
You can make sound by tapping the table with your knuckles. You can blow a stream of air with your mouth and intercept it with your finger to make sound. You could tap a glass with a spoon to make noise. In every case you make a sound by doing something. Sound is always connected with doing something. Sound is connected with motions of objects or materials. When two objects strike each other they begin to vibrate rapidly, faster than the eye can see. This vibration shakes the air and sets it in motion. The vibrations of the air move outward in the form of a wave. These vibrations are heard as “sound” by the ear.



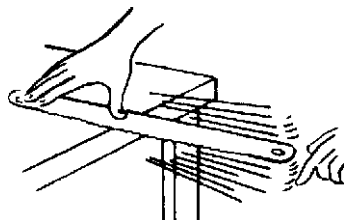
Rub the teeth of a comb with your fingers.



Make a stethoscope from a large funnel and a flexible tube. Use it to listen to your heartbeats.



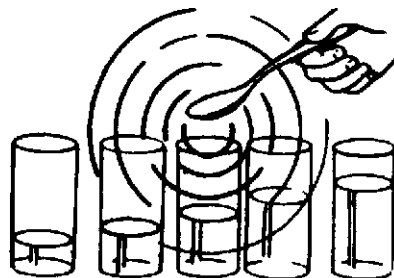
Place a hacksaw blade on the table, with most of it sticking out. Hold one end and pluck the free end. You will hear a noise. Shorten the sticking piece and try again. Continue to shorten it. Soon you will hear a low musical sound.



Blow across the top of a small pen cap or test tube. The air in the tube is set into rapid vibration and makes a high-pitched tone. A taller bottle will give a lower tone.



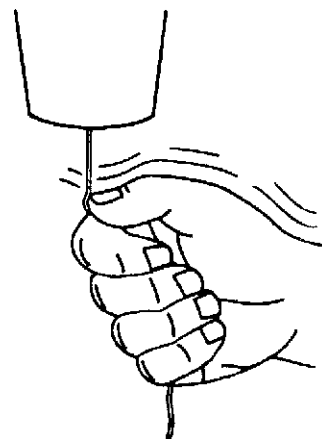
Take several glasses and fill them up with different amounts of water. Tap them with a spoon to make sound. Make a *Jaltarang* by adding water to the glasses. Instead of glasses you can also use beer bottle containing different quantities of water.



## ROARING CUP

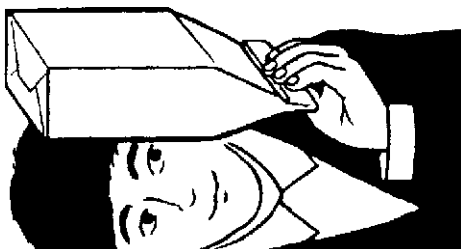
Take a paper or thermocole cup. Tie a large knot at one end of a string about 40-cm long. Make a small hole in the centre of the bottom of the cup. Weave the string through the hole. The knot should prevent the string from coming out. Rub your thumbnail down the string while squeezing and pulling the string tightly. You should hear a roaring sound. Why?

The cup acts as a cavity, which increases sound. A cavity helps to amplify and prolong sound because sound waves inside the cavity hit the walls, bounce back and reinforce each other. The roaring cup is a popular toy.



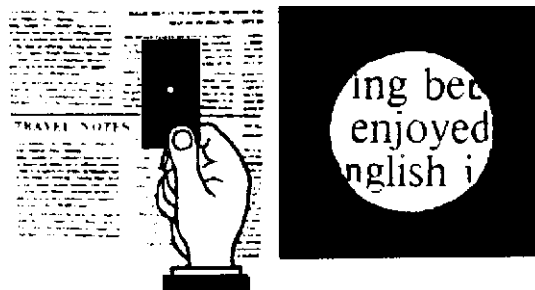


### FOOTSTEPS IN THE BAG



Put a housefly in a paper bag and close it. Hold the bag horizontally above your ear. If you are in a quiet room you can hear the patter of the six legs and other rather curious noises quite clearly. The paper behaves like the skin of a drum. Although only the tiny legs of the fly beat on it, it begins to vibrate and transmits such a frightening noise!

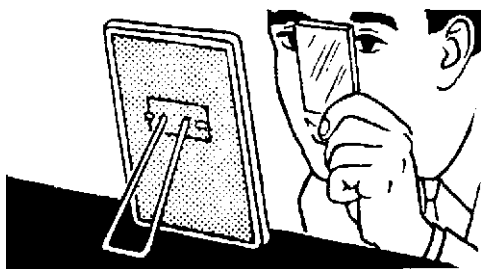
### UNUSUAL MAGNIFICATION



Make a small hole in a card with a needle. Hold it close to the eye and look through it. If you bring a newspaper very close you will see to your surprise the type much larger and clearer.

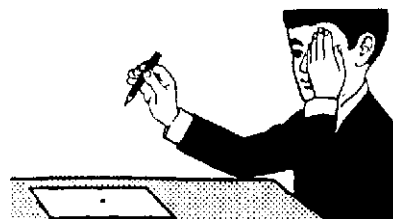
The phenomenon is caused by the refraction of light. The light rays passing through the small hole are made to spread out, and so the letters appear larger.

### VIEW INTO INFINITY



Hold a pocket mirror between your eyes so that you can look to both sides into a large mirror. If you place the mirrors parallel to one another, you will see an unending series of mirrors stretching into a distance.

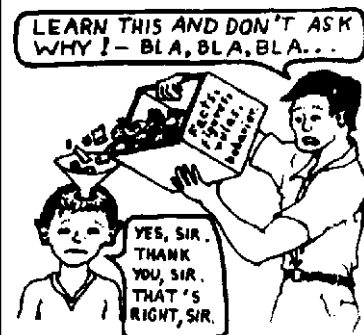
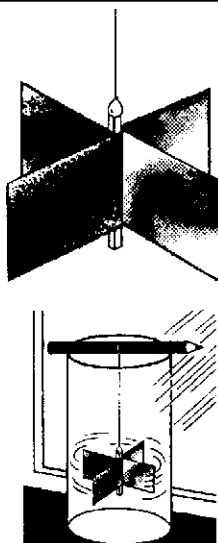
### MEASURING DISTANCE



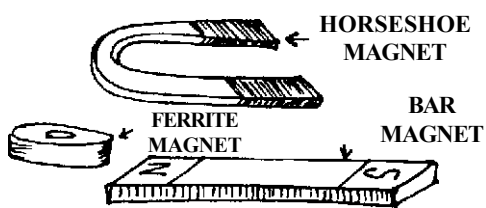
Make a point on a piece of paper and place it in front of you on the table. Now try to hit the point with the pencil held in your hand. You will manage it quite easily. But if you close one eye, you will almost always miss your target. The distance can only be estimated with difficulty with one eye. One normally sees a composite image with both eyes and so can discern the depth of a space.

### LIGHT MILL

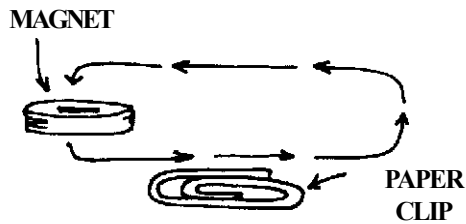
Cut four pieces of aluminium foil 2.5-cm x 4-cm. You can use the silver paper from cigarette packs after removing the backing. Stick the sheets on to a matchstick like the blades of a windmill, with the bright sides all-facing in the same direction. Blacken the matt sides over the candle. Put a drop of glue at one end of the match and attach a fine thread. Place a tall jar in the sun, hang the mill inside, and it soon turns without stopping. We know that dark surfaces are more strongly heated by sunlight than the light ones. And this heat difference is the secret to the light mill. The sooty side of the foil absorbs the light rays and is heated about 10 times more strongly than the light reflecting bright side. The difference in the amount of heat radiated from the sides of the blades causes the rotation.



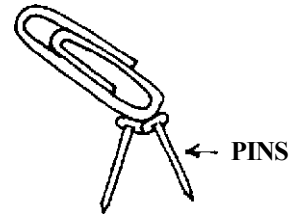
## MAKE A MAGNET



1. Any kind of magnet can be used to convert a steel object into a magnet.

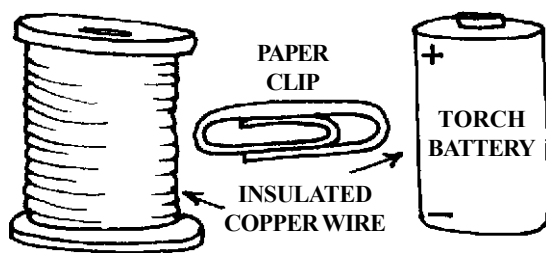


2. To magnetise a paper clip, rub the paper clip with a magnet. Rub many times but only in one direction.

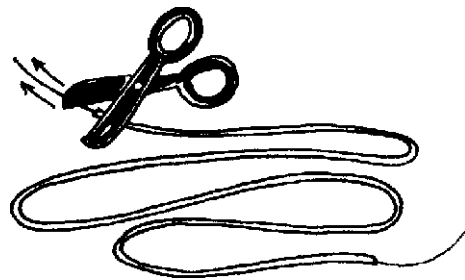


3. Now your paper clip magnet will be able to attract and lift a few paper pins.

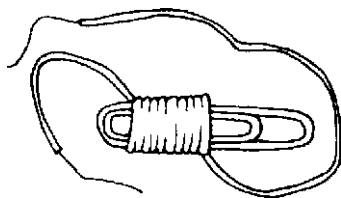
## MAKE AN ELECTROMAGNET



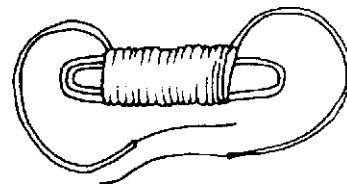
1. You will need a large paper clip or nail, 30-cm of bell wire and a torch battery.



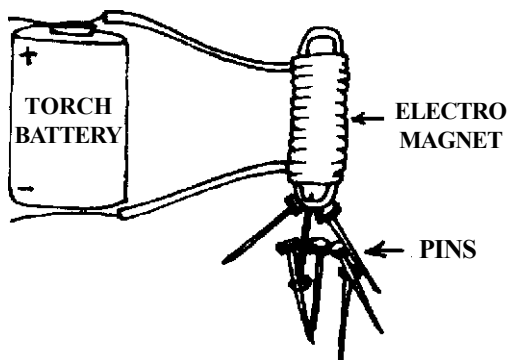
2. With a scissors or blade carefully strip the plastic insulation off both the ends of the wire.



3. Wind the wire neatly onto a large paper clip.



4. Keep winding until only two tails remain.



5. Connect the ends of the wire to the two terminals of a torch battery. The clip should be able to attract a few pins.

6. Perform a few experiments with your electromagnet.

- How can you measure the strength of your magnet?
- What types of things can be made into a magnet?
- Which materials are attracted to the magnet?

## EGG CARTON CATERPILLAR

Join the modular units of an egg carton to make a caterpillar. Make horns and antennae using wires. Paint it make it look realistic.



(Pix: MAKING THINGS by Ann Wiseman)

## RUBBER BAND ENLARGEMENTS

This is a simple mechanism to enlarge pictures.

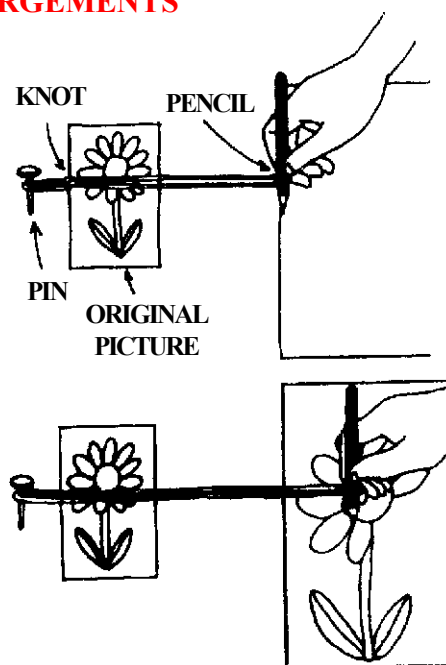
Knot a small and large rubber band together.

Hook one end of the small rubber band to a drawing pin and attach it to a drawing surface.

Place your original picture so that its left edge is lined up underneath the knot. The rubber band should be tight.

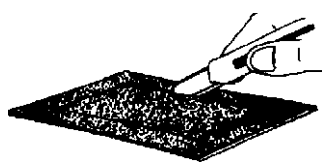
Insert a pencil at the other end of the rubber band.

Hold the pencil firmly (and vertically) in the rubber band. With the knot follow the outlines of the picture. The pencil will produce an enlarged picture.

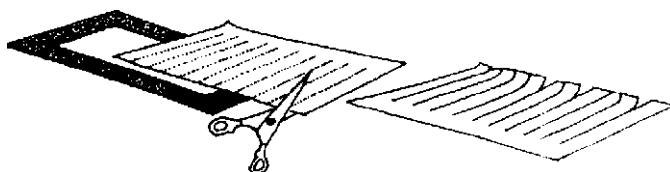


## PATHFINDER

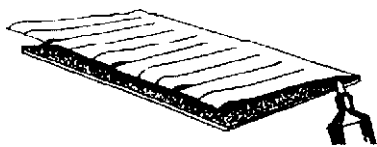
This brilliant idea won the National Award in China, for the best designed teaching aid in 1988. To locate the position of a moving particle you will require some fairly expensive and sophisticated gadgets. The paper reed pathfinder enables you to do that at almost zero cost.



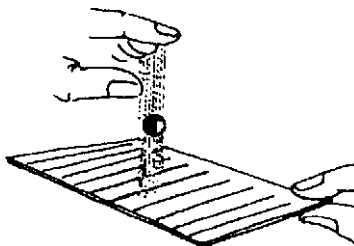
1. Remove the centre from a 10-cm x 20-cm piece of cardboard leaving a 1-cm wide frame.



2. Take a 10-cm x 20-cm sheet of paper, and leaving aside 1-cm along its length, cut parallel strips along its width.



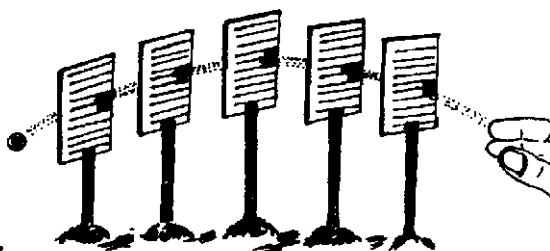
3. Apply glue along the uncut length of this paper reed and stick it along one long edge of the frame.



4. Hold the edge of the frame with one hand and drop a marble into the frame. The marble will strike the reeds and at the point of strike, the reeds will go below the frame.



5. This enables you to locate the position of the particle.

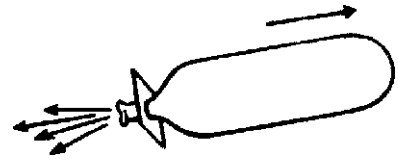


6. The path of a moving marble can be found by placing several such mounted frames along its approximate trajectory. On throwing, the marble will pass through all the frames. The reeds will go behind each frame at the point of strike. Of course, the thinner the strips the more precise can the position of the particle be located.

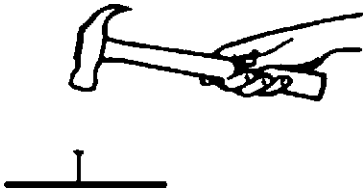
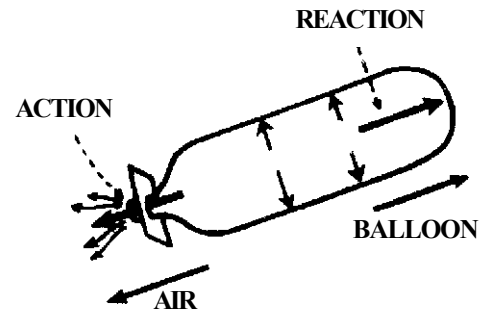
## SIMPLE SATELLITE MODELS

With a few balloons, thread spool, cardboard and other trinkets you can make a simple satellite model.

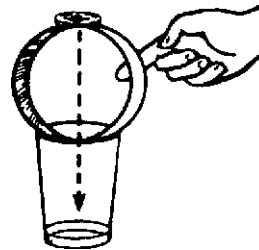
When you release a blown-up balloon it will zoom around the room. You can give this simple rocket a bit more control and make it last longer by putting a cardboard collar around the open end.



For the collar cut a 2.5-cm square card. Punch a hole right in the centre with a pencil point. Push the pencil all the way to enlarge the hole. Now put the mouth of the deflated balloon in the card hole. Blow up the balloon as much as you can and let it go. When you blow up a balloon the air inside presses equally against all sides of the balloon and therefore blows it up. As the open end is released the air rushes out. That's the action, in a backward direction. An equal and opposite reaction inside the balloon sends it forward.



Drive a nail into a plank of wood using a very light hammer. The nail moves into the wood very slowly. With a heavy hammer the nail will move in fast.

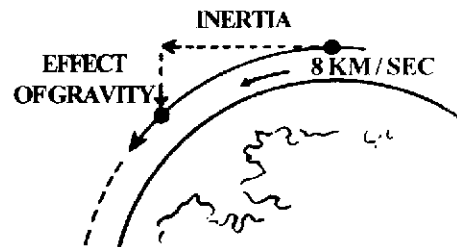
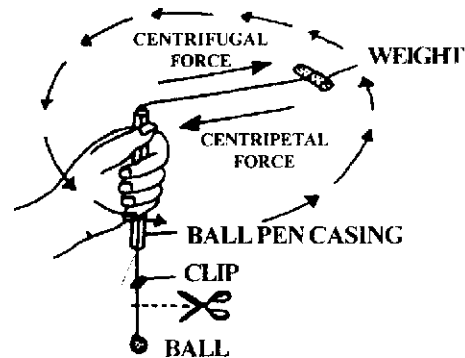


Put a coin on a paper hoop on a open glass. Pull out the hoop suddenly. Inertia leaves the coin in mid-air. Gravity then pulls it down into the glass.

## SIMPLE SATELLITE MODEL

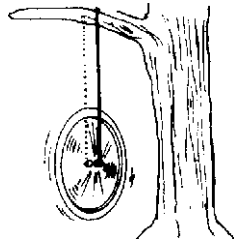
Make a simple model of an earth satellite using a ball pen casing, thread and a few small trinkets. Tie a weight to one end of the string and a ball on the other. Hold the pen and rotate so as to set the weight whirling over your head. If you now cut the thread you will find the weight flying away.

An earth satellite stays up for a similar reason. Scientists have figured out that at a speed of 8 km /sec the effect of inertia is exactly right to balance the weight of an object moving parallel to the ground. In fact, if it were to go any faster than 8 km / sec it will actually pull itself away from the earth and take an enlarged oval path. At 11.2 km /sec, inertia would be so great that a rocket could actually coast out into space and get away from the earth completely.

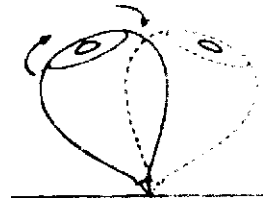


## BICYCLE SCIENCE

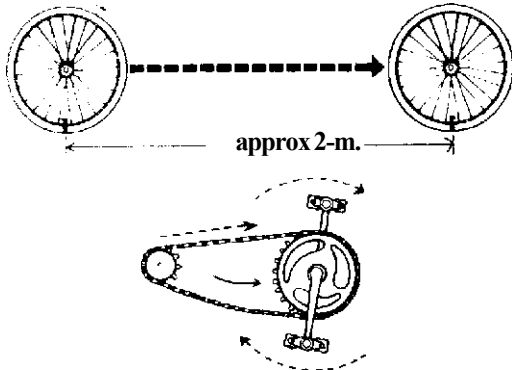
Take an old bicycle wheel. Support both sides of the axle with ropes and spin the wheel rapidly. Remove one rope from the axle. The spinning wheel does not fall because of gyroscopic action. Instead, it slowly turns around.



Try to knock over a spinning top. It resists your force and maintains its upright position. As it slows down it wobbles and finally topples over. These actions are similar to those of the spinning wheels of a bicycle.



## DISTANCE IN ONE ROTATION



Measure the distance on the ground when the cycle wheel makes one complete turn. The distance will be approximately 210-cm (7 feet). This is the distance that your bicycle moves when the rear wheel turns around once.

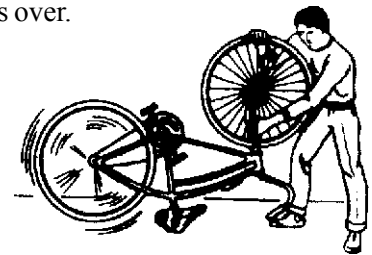
How far does the bicycle move when you rotate the pedal once? One turn of the pedal makes the wheel turn about 3 times. It is therefore approximately 630-cm (21 feet). Check this by actually riding the bicycle.

## GYROSCOPIC ACTION



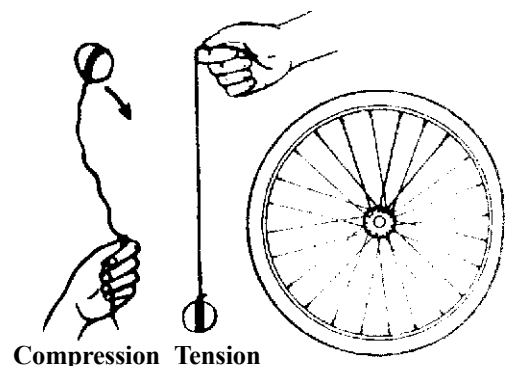
Why is it easier to keep your balance on a bicycle when it is moving fast? Why does it become imbalanced when it is moving very slowly? Make a coin stand on edge. It is difficult and you are likely to fail. But give it a push so that it rolls. Now it remains on edge. As it slows down it begins to wobble and finally topples over.

A similar action occurs when the bicycle wheels spin. Turn the bicycle upside-down, standing it on the seat and handle. Turn the pedals by hand and make the back wheel spin rapidly. While it is spinning try to tilt the bicycle slightly, sideways. You will feel a resistance to your toppling force. Once the wheel stops spinning you can turn the bicycle over more easily.



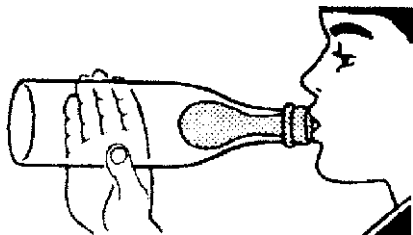
## RIDING ON WIRES

Notice the bicycle wheel is made of spokes. It would be easy to make a strong wheel out of solid steel. But that would make the bike heavy and harder to move. The bicycle is made much lighter by using thin, spokes for the wheels. How do these wires hold up your weight? Fasten a thin wire to a stone. Try to have the stone stay up in the air over the wire. It falls and twists the wire. But when you hang the stone, the wire becomes very strong and holds a great deal of weight. The bicycle wheels are made in such a way that there is always a group of wires in position to be stretched to hold up your weight. As the wheel rotates, different spokes come into proper position to exert their maximum strength and hold up weight.



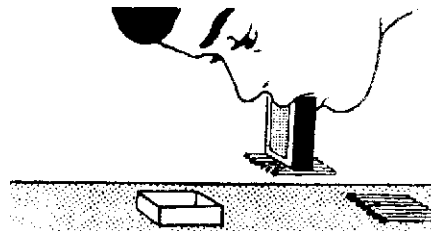
**Compression    Tension**

### BALLOON IN A BOTTLE



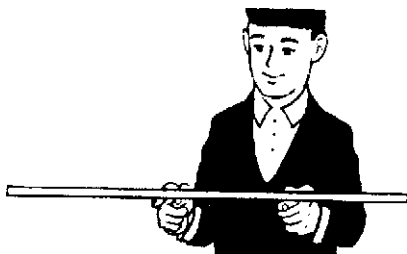
Push a balloon into a bottle and stretch its mouth over the opening. Blow hard into the balloon. You will not be able to blow up the balloon, no matter how hard you try. As the pressure in the balloon increases so does the counter-pressure of the air enclosed in the bottle.

### MATCHLIFT



It is simple, using air to lift matches from the table into their box. Hold the case between your lips and lower it over the matchsticks. Draw a deep breath, and the matches hang on to the bottom of the case as if they were stuck on.

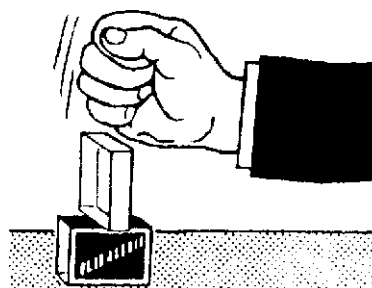
### MAGIC ROD



Lay a rod over your index fingers so that one end sticks out further than the other. Will the longer end become unbalanced if you move your finger further towards the middle?

The rod remains balanced however much you move your finger. If one end becomes overweight it presses more strongly on the finger concerned. The less loaded finger can now move further along until the balance is restored. The process can continue under the combined effects of the force of gravity and friction until the fingers are exactly under the centre of the rod.

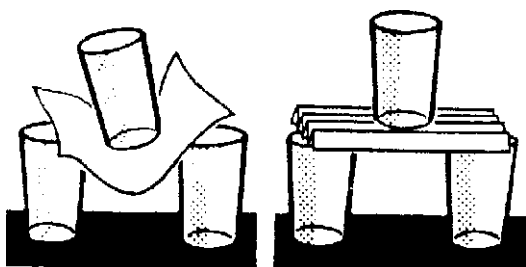
### UNBREAKABLE MATCHBOX



Put the outside case of a matchbox on the table. Place the inner drawer on its striking surface. Now challenge someone to smash the matchbox with one blow of the fist! Try it. The box nearly always flies off undamaged in a high curve.

The matchbox is so strong because of its vertical joined sides that the pressure of the striking fist is transmitted to the outside without smashing it.

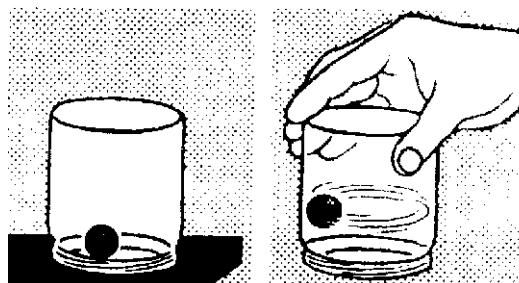
### PAPER BRIDGE



Lay a postcard as a bridge between two glasses, and place a third glass on it. The bridge collapses. But if you pleat the postcard, then it supports the weight of the glass.

Now think about corrugated paper and corrugated galvanized iron sheets used for roofs.

### SPINNING BALL

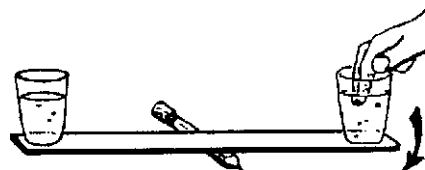


Place a marble on the table, with a wide-mouthed bottle upside down. Make turning movements with the bottle and thus set the ball rotating too. The ball is pressed against the inner wall of the bottle by centrifugal force. You can now carry the ball in the bottle as far as you like.



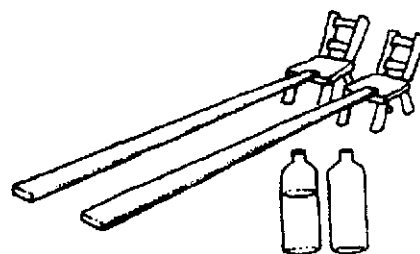
### DELICATE BALANCE

Fill two glasses nearly full of water. Place a pencil under a ruler to make a balance. Put one glass of water on each end of the ruler. Hold each glass until it is balanced. Now move the pencil along under the ruler until the raised end is almost ready to tip downward. Put two fingers into the water without touching the glass. As your fingers move down the glass will also move down. The level of water will rise in the glass as your fingers push into the glass. Your fingers displace water, which causes the water level to rise. The glass's weight is increased by exactly the amount of water that is displaced.



### BOTTLE RACE

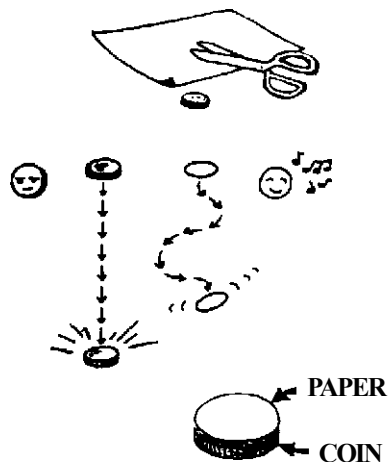
Fill a plastic bottle half with water. Screw on the cap. Leave the second bottle empty. Roll them down two ramps and notice what happens. The water filled bottle starts faster. But when the bottles reach the level floor the empty bottle rolls further than the water bottle. The water in the bottle gives it extra weight. This added weight makes it takes off faster down the slope. But the water rubbing against the sides of the half-filled bottle creates friction, which slows it down.



### COIN AND PAPER RACE

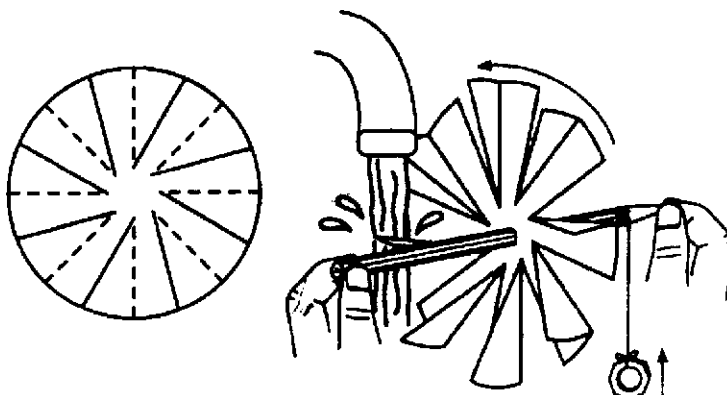
Cut a round paper, which is little smaller than the coin. Now hold the coin in one hand and paper in the other about 1-meter above the floor. Drop them both at the same instant.

The coin - being heavy takes off for the floor in a straight line. The paper being light flutters in the air and takes a longer time to reach the floor. Now hold the paper and the coin in the same hand. Keep the paper on top of the coin. Hold the coin by the edges so that you don't touch the paper at all. Drop them together. What happens? The coin and the paper should travel together all the way to the floor. If however, any air gets in between them then the paper will flutter as before. If this happens, try again. The coin and the paper travel together because of the moving air. The paper 'rides' on the coin because it is caught in the air travelling with the speeding coin.



### WATER WHEEL

Mark 8 equally spaced cuts (dotted lines) on an aluminum foil disk. Each end cut should be 2-cm from the centre. Phase out the cuts to make the vanes of a water wheel. Make a hole in the middle to press fit a pencil. A dab of adhesive will keep the wheel in place. Hold the wheel under a stream of water to make it turn. Tie a string at one end of the pencil and attach a small steel washer to the other end. The water wheel should wind the string onto the pencil, lifting the weight. How much load can it lift?





## RECYCLE! REUSE! REDUCE!

This ancient story carries a deep lesson about conservation in a consumerist society.

We buy, use and throw. Often we buy much more than we actually need. The whole consumerist culture is based on the principle: “Buy more! Throw more!” Today as we splurge - we plunder the earth’s scarce resources and produce so much junk that not only our garbage dumps but even our parks overflow with rubbish.

But has it always been like this? Have we Indians always been so profligate and wasteful? No. History tells us that Indians have been fairly austere. They have had a different way of looking at the material world. According to this viewpoint a thing can have several uses. Not just one, but several lives. The concept of reuse/recycle has very deep roots in the Indian culture. This 5,000 year old story shows a deep respect and sensitivity for the material world. It has many lessons for modern day environmentalists.

One day the great Buddha was taking a round of the monastery.

He was approached by a monk who wanted a new woolen shawl (*angarkha*).

Buddha asked him, “What happened to your old shawl?”

“It had become very old and worn out. So I am presently using it like a bed sheet,” replied the monk.

Buddha asked again, “But what happened to your old bed sheet?”

“Master, that bed sheet got old with use. It was worn and torn. So I cut it up and made a pillow cover out of it,” replied the monk.

“But there certainly was a pillow cover before you made a new one. What did you do to your old pillow cover?” asked the Buddha.

“My head had rubbed a million times against the old pillow cover and made a big hole in it. So I made a foot mat out of it,” replied the monk in earnest.

Buddha was not satisfied by this answer. He always delved deep into any issue. In the end he asked the monk, “Tell me what did you do with your old door mat?”

The monk replied with folded hands, “Master the old door mat had got totally worn with use. Because of repeated use the warp and the weft had come out. So I took the cotton fibers and braided a wick out of them. Later I burned the cotton wick in the oil lamp.”

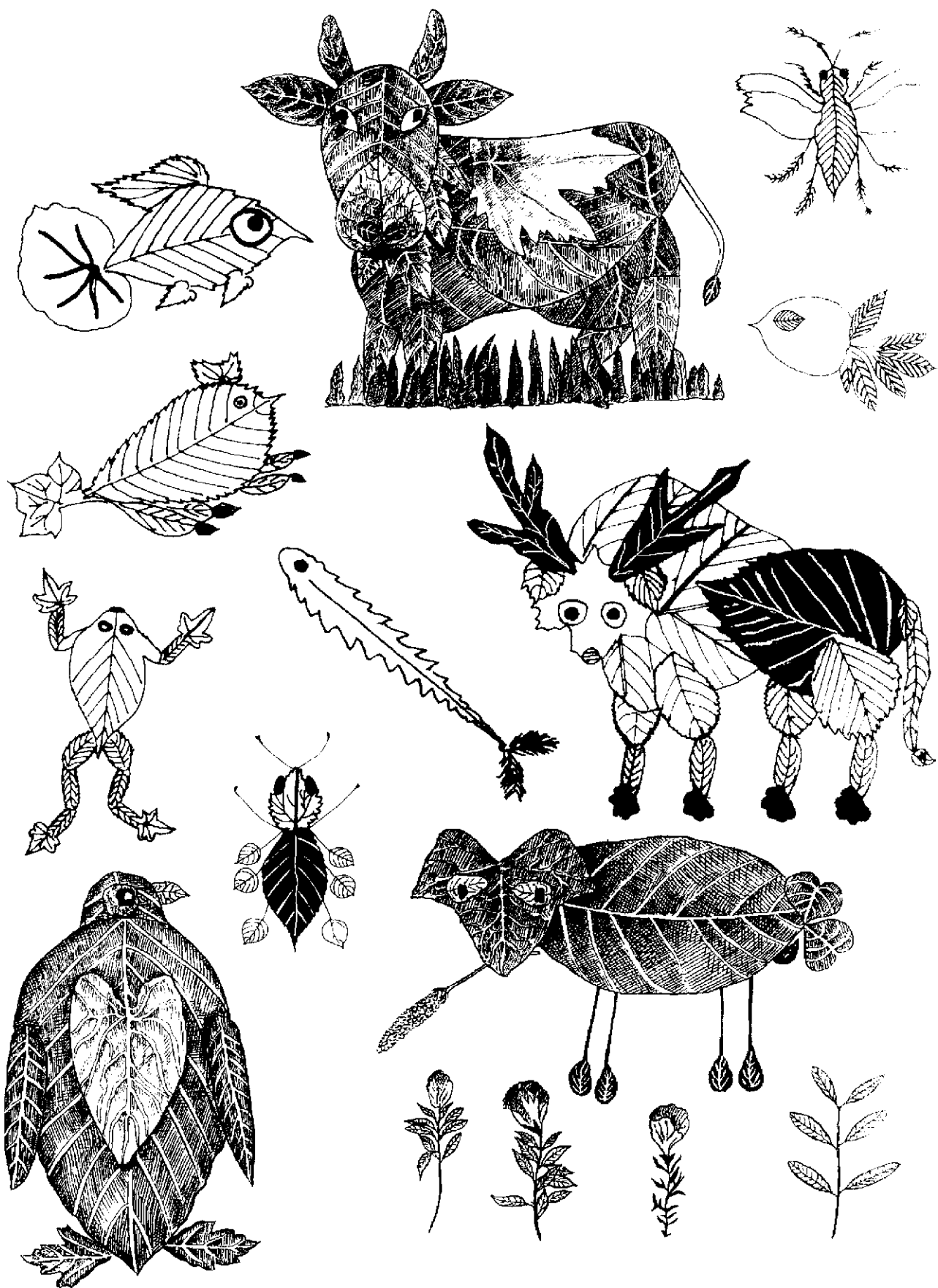
Buddha smiled after listening to the monk. The monk got a new shawl.



## FUN WITH LEAVES

It is possible to make many animals, birds and insects using leaves.





*(Pix: Avinash Deshpande)*

## HOW KIND ARE WE TO OUR EARTH?

Earth has enough for everybody's need, but not for anybody's greed.

Our wasteful lifestyle puts additional stress on the natural resources. Below are some examples of our daily actions, which harm the earth. Are you responsible for some of them? (Courtesy: Delhi Environment Action Network)



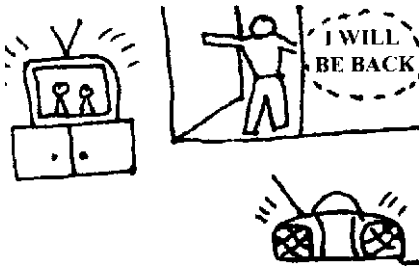
1. He does not turn off the tap while brushing his teeth.



2. She takes a long shower instead of using a bucket.



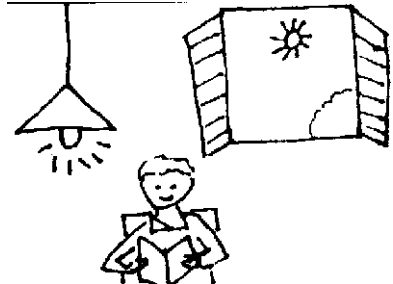
3. She uses a lot of soap and shampoo, while bathing and washing.



4. He leaves the TV and music on even when he is not around.



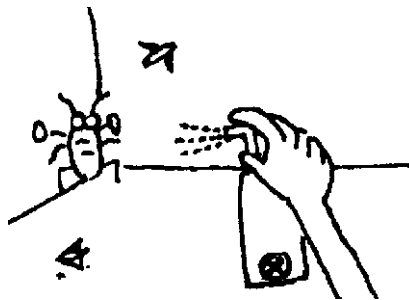
5. She is opening and closing the refrigerator all day.



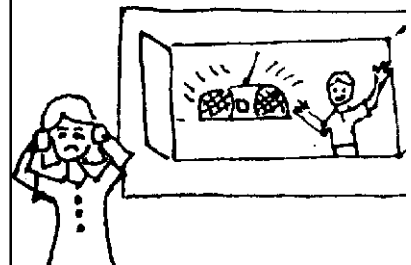
6. He uses lamps even during day time.



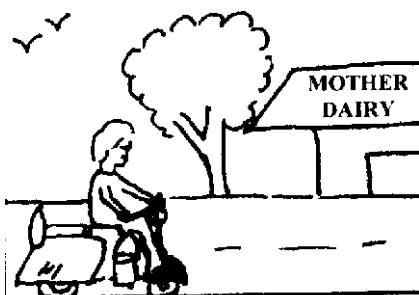
7. She does not eat everything on her plate and has many leftovers.



8. He uses insecticides and sprays to kill insects.



9. Whenever he plays music or TV, it is at a loud volume.



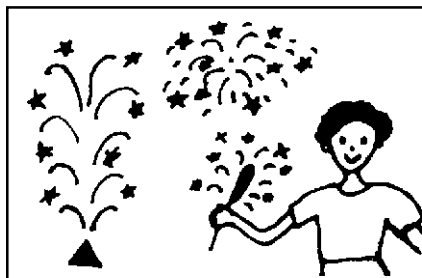
10. He uses his vehicle even if the distance is walk able.



11. She does not get pollution checked for her vehicle.



12. He uses battery rather than electricity (mains) for his gadgets.



13. He bursts crackers on *Diwali* and other occasions.



14. She submerges idols painted with harmful colours into the river.



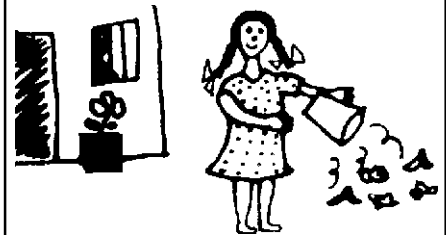
15. He plays *Holi* with toxic colours and dyes.



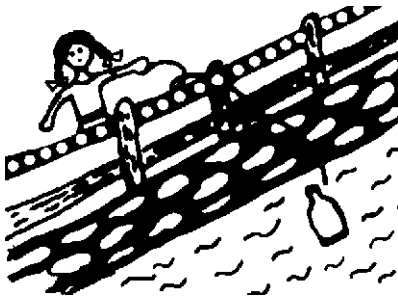
16. She likes to use disposable plates and glasses.



17. He uses disposable and one time usable things - razors, jotter pens etc.



18. She cleans her house and throws the garbage outside.



19. She throws litter on streets and rivers.



20. He breaks leaves and stems of trees in public parks.



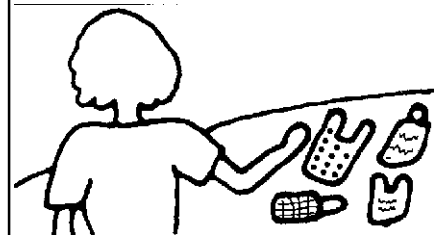
21. She burns her garden waste and does not compost it.



22. She buys animal products like fur, leather, ivory, skins etc.



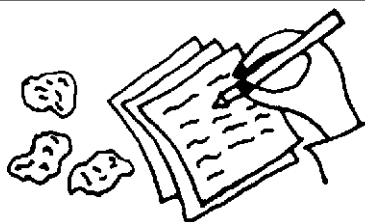
23. She shops in separate plastic bags and not uses jute or cloth bags.



24. He throws plastic bags after using them only once.



25. She uses tissue paper endlessly.

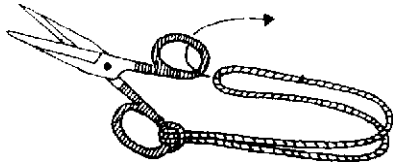


26. He photocopies / uses only one side of the paper.

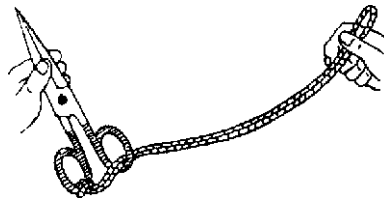


27. On picnic / holidays she leaves behind her garbage carelessly.

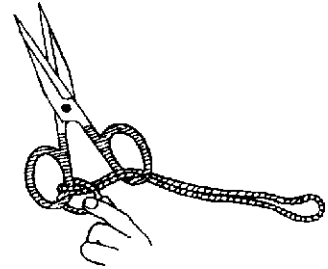
## THE GREAT ESCAPE



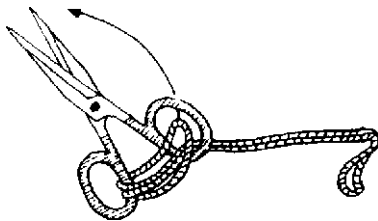
1. Loop the string as shown.



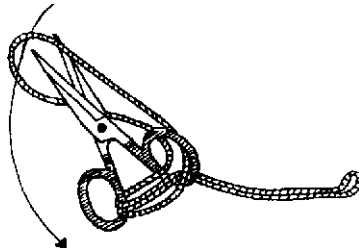
2. Hold one end of the loop and give the scissors to a friend and ask him to free the scissors from the loop of string without cutting it.



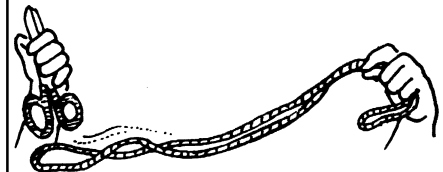
3. The way to do this is to loosen the loop knot made in Figure 1 and pull the loop through....



4....the opposite finger hole.

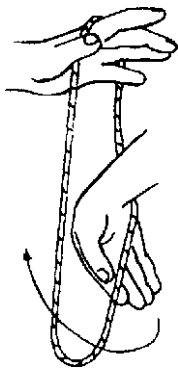


5. Pass the loop all the way over the scissors. Do not twist it around.

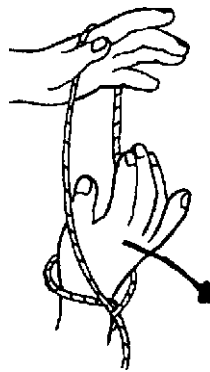


6. By pulling on the other end of the loop string you will be able to free the scissors.

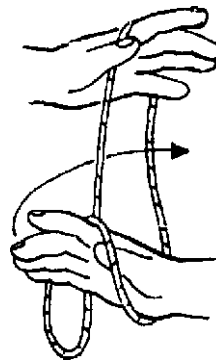
## HAND TRAP



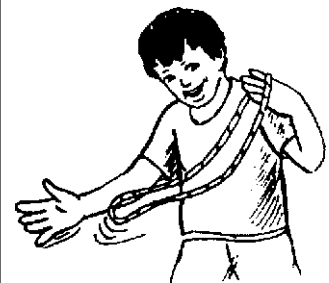
1. In front of a friend place a loop of string over your left hand. Put your right hand (downwards) inside the loop and swing it around and up.



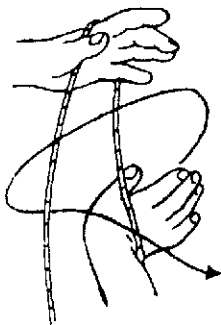
2. Put your hand right into the back of the loop.



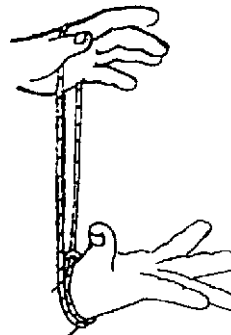
3. Pull your hands apart.



4. The string will be freed from your right hand.

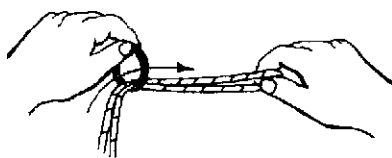


5. Now give the loop of string to a friend and ask if he can repeat the trick. Your friend will probably mistake the direction of the swing and go around the loop in the wrong direction.

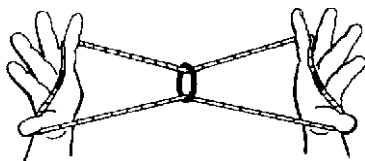


6. And his hand will be caught in a trap.

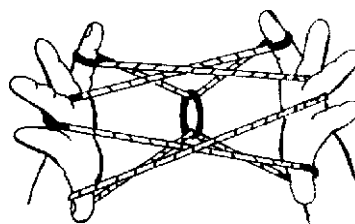
## RING AND STRING



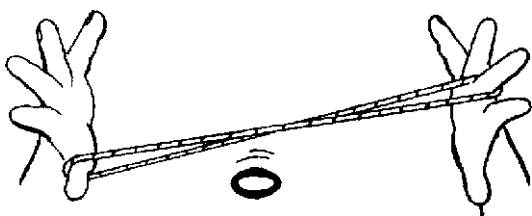
1. Put one end of a loop of string inside a ring. Pull the string to bring the ring in the middle.



2. Now loop the string across both your palms and behind your little fingers and thumbs. Do not twist the loop of thread around.

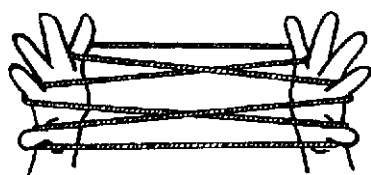


3. Pick the left palm string with your right middle finger and your right palm string with your left middle finger. Now release the strings of the little fingers, the left middle finger and the right thumb.

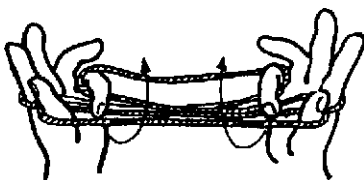


4. Be careful not to release the right middle finger and left thumb strings. On pulling your hands apart the ring will get freed.

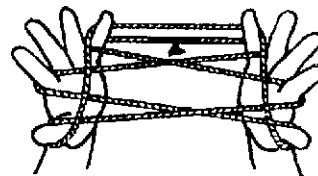
## MAN CLIMBING A TREE



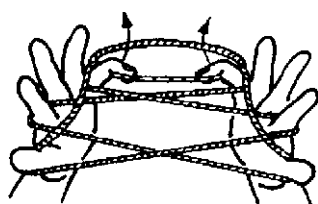
1. Start with the Index Finger Base, as shown.



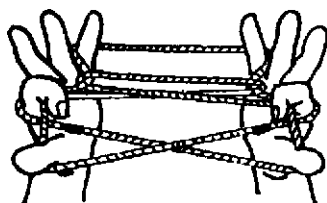
2. With your little fingers scoop up the near string and pull it back.



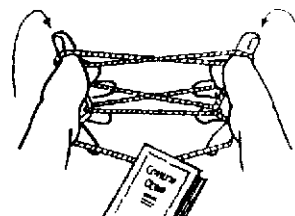
3. This should be the finished result. Release the string indicated by the arrow.



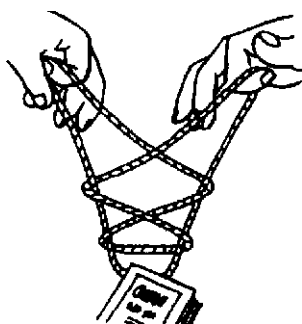
4. This picture shows the releasing action.



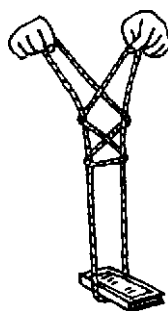
5. Bend your index fingers down and tightly hold the string that goes across them.



6. Twist your hands away from you. Use a book to hold down the far bottom string on the floor.



7. Now hold the index finger strings tightly and release all the other strings.



8. By alternately pulling upwards on each of the index strings you can make the man climb up the tree.

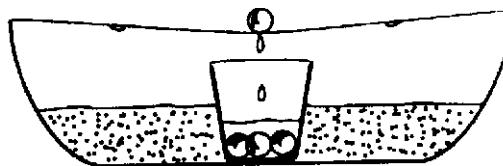


## SIMPLE SOLAR STILL

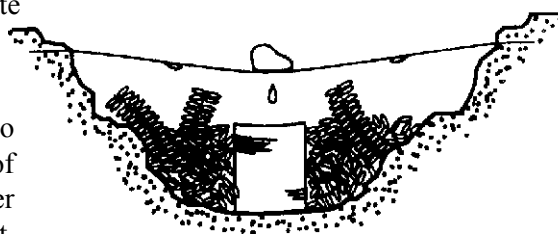
The sun can help you purify water.

Take a large pan. Fill it with some muddy water. Place a glass in the middle. Place some clean marbles in the glass to weigh it down. Cover the pan with a thin plastic sheet. Tie a string all around the pan to secure the sheet in place. Place a small stone on the sheet to make it dip in the centre. The plastic should not touch the glass.

Now place the pan in direct sunlight. Heat will evaporate the water, which will condense and collect in the glass.



Make a hole in the ground. The hole should be big enough to sink a clean container. Surround the container with a lot of fresh leaves and plants. Place a sheet of plastic loosely over the hole. Secure the plastic by placing stones all around it. Put a stone in the middle to make the plastic sag.

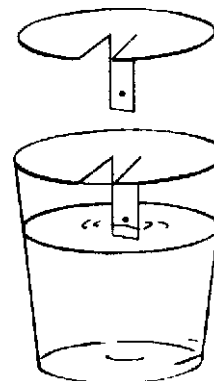


Dewdrops can meet the drinking water requirements of a desert village. By harvesting the dew that collects on rooftops, each house in a desert village in Gujarat can get about 20-liters of potable water overnight. Dew is nearly as clean as distilled water. Plastic and tin cool quickly and so will easily gather dew from the water vapour in the air. Roofs can be made of sloped tin or plastic sheets. Plastic pipes fitted to the edges of the roof can gather the dew and run it to a container at ground level. A roof of 200-square meters can harvest nearly 20-liters of water a day and with hardly any dissolved salts.

## SKETCH PEN SECRETS

The inks in markers, sketch pens are often combinations of several basic coloured dyes. Here is a simple way of checking the combination of colours in your sketch pen. Cut a 10-cm disc of blotting as shown to make a strip that will hang down. Make a different strip for each colour. Make a large dot, about 2-cm up from the bottom of the strip.

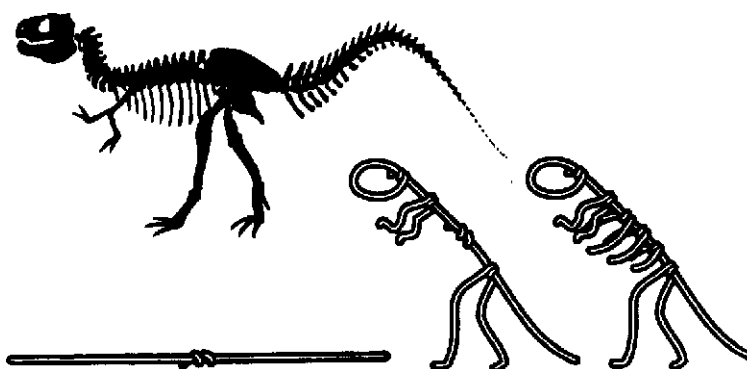
Fill the water with glass so that the water is below the colour mark. Place the disk on the glass with the end of the strip just touching the water. The colour separation will take a few minutes. Which colour contains the most other colours? Which colours refuse to separate? Which colours move the highest on the strip? Does the temperature of water affect the separation?



## WIRED UP DINOS

Dinosaurs lived millions of years ago. They disappeared because they could not adapt to the changes around them.

Using thin aluminium wire you can make skeletal models of a few dinosaurs. Start with the backbone and later add the head. Then connect the hands and the legs at the correct positions. In the end model the ribs.



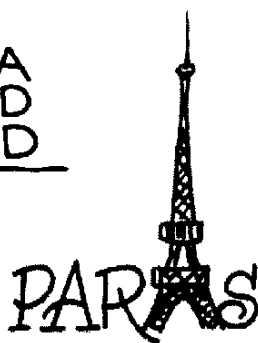
# WORD PICTURES

Scissors

ADD

DIODE

Hexagon



oval

TRIANGLE

AERIAL

ROUND

SQUARE

Lever

PYRAMID

TRAPESIUM

DI VIDE

BLOCK

CONE

FIS SION

ANATOMY

PENTAGON

WAVE WAVE WAVE

DIAMOND

PhOTO

E\*PONENT

ECLIPSE

FRAC  
TION

GRAPH

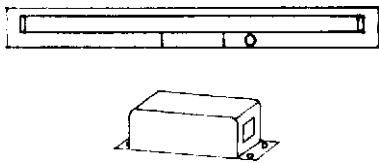
DIVIDE

Electricity

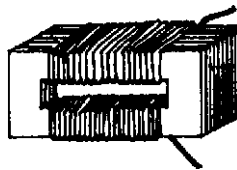
Parallel

## 220 - VOLT A. C. MOTOR

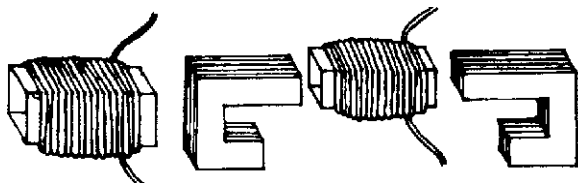
This motor was designed by Somnath Dutta. Prof C. K. Desai of the *Exploratory*, Pune presented me a model.



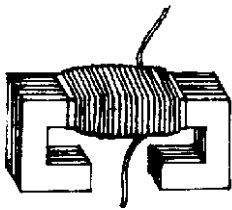
1. Open a burnt tube light choke.



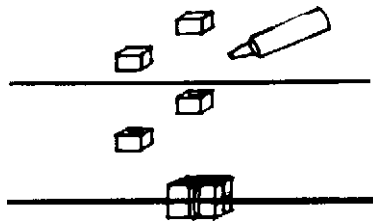
2. Inside the casing you will find copper wire wrapped on two U shaped laminations. Discard the burnt copper wire.



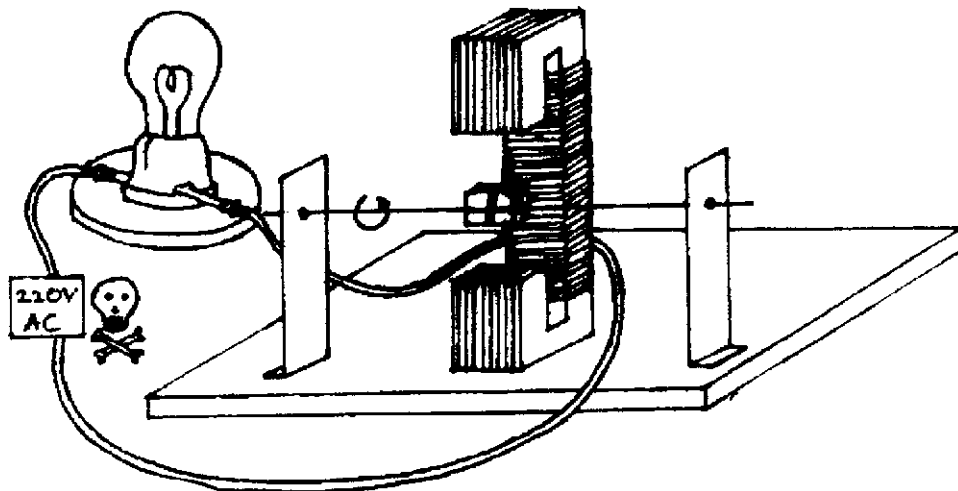
3. Make a cardboard square section spool. The two U shaped laminations will fit in this spool. Wind 1,200 turns of 30 gauge insulated copper wire (motor rewinding wire) on this spool. Insert the U shaped laminations in the spool. Mask the laminations with insulation tape.



5. This will be the finished coil.



6. Take a 20-cm long bicycle spoke and stick four small rectangular magnets on it as shown. You can also tie the magnets with thread to anchor them.



7. Place the coil on a wooden board as shown and anchor it in place. Connect one end of the copper wire of the coil in series to a 75-watt light bulb (220-volt). The other end of the coil and the bulb can be connected to the 220-volt A.C. Mains through a switch. Mount the cycle spoke on two brackets so that the spoke can rotate freely and the magnet block is between the facets of the lamination. Now, put the switch **ON**. If you now give a small rotation to the spoke, it will keep rotating.

**CAUTION:** THIS EXPERIMENT SHOULD BE STRICTLY DONE UNDER ADULT SUPERVISION. UNDER NO CIRCUMSTANCES TOUCH THE “U” SHAPED LAMINATIONS OR WIRES WITH YOUR BARE FINGERS, AS THE 220-VOLT A.C. CURRENT CAN GIVE A FATAL SHOCK.

(Pix: Dr. Vidula Mhasikar)

## REFERENCES

1. **The Most Beautiful Mathematical Formulas**, L. Salem, F. Testard, C. Salem, John Wiley.
2. **Mathematical Cavalcade**, Brian Bolt, Cambridge University Press.
3. **Second Book of Mathematical Bafflers**, Ed. Angela Fox Dunn, Dover Publishing Inc.
4. **Helping Health Workers Learn**, David Werner and Bill Bower, VHAI, India.
5. **Teach Yourself Origami**, Robert Harbin, Hodder and Stoughton.
6. **Newspaper Magic**, Steve and Megumi Biddle, Beaver Books.
7. **The Science Teacher's Handbook**, Andy Byers, Ann Childs, Chris Lane, VSO.
8. **The Underground and Education**, Mark Smith, Methuen & Company.
9. **Low cost, No cost Teaching Aids**, Mary Ann Dasgupta, National Book Trust, New Delhi 110016.
10. **The Historian's Toybook**, E. P. Provenzo, A.B. Provenzo, P. Zorn, Prentice-Hall.
11. **A Mathematical Jamboree**, Brian Bolt, Cambridge University Press.
12. **The I Hate Mathematics! Book**, Marilyn Burns, Cambridge University Press.
13. **Math For Smart Pants**, Marilyn Burns, Scholastic.
14. **Tricks and Games with Paper**, Paul Jackson, Angus & Robertson.
15. **1,001 Uses of the Hundred Squares**, Leah Mildred Beardslay, Parker Publishing Co.
16. **Science Is**, Susan V. Bosak, Scholastic.
17. **Paper Fun**, Eric Kenneway, Beaver Books.
18. **Paper Shapes**, Eric Kenneway, Beaver Books.
19. **String Games**, Arvind Gupta, National Book Trust, A-5, Green Park, New Delhi 110016.
20. **Little Toys**, Arvind Gupta, National Book Trust, India.
21. **The Toy Bag**, Arvind Gupta, Eklavya, E7- 453, Arera Colony, Bhopal, 462016.
22. **Toy Treasures**, Arvind Gupta, Eklavya, E7- 453, Arera Colony, Bhopal, 462016.
23. **Learning from Gandhi**, Anu Bandopadhyaya, Other India Bookstore, Mapusa, Goa 403507.
24. **danger School!** IDAC Document, Other India Bookstore, Mapusa, Goa 403507.
25. **Project Number Fun**, Gyles Brandreth, Corgi Carousel.
26. **700 Science Experiments for Everyone**, Compiled by UNESCO, Doubleday.
27. **100 Amazing Science Fair Projects**, Glen Vecchione, Goodwill Publishing House, New Delhi.
28. **ABC Zoo**, Detlef Kersten.
29. **The Little Giant Book of Optical Illusions**, Keith Kay, Sterling Publishing Co. Inc.
30. **How to make and use Visual Aids**, Nicola Harford and Nicola Biard, VSO.
31. **365 Simple Science Experiments with Everyday Materials**, Richard Churchill, Sterling Publishers.
32. **The Book of Experiments**, Leonard De Vries, Carousel.
33. **Science & Technology by Design Parts 1 & 2**, Colin Webb, Orient Longman, India.
34. **Joy of Learning** (Standards 3 to 5) Center for Environmental Education, Ahmedabad, India.
35. **Adventures with a Straw**, Harry Milgrom, Reader's Digest Services Inc, New York.
36. **Let's Explore Mathematics**, L. G. Marsh, A & C Black, London.
37. **When? Experiments for the Young Scientist**, Robert W. Wood, Tab Books.
38. **Messing around with Drinking Straw Construction**, Bernie Zubrowski, Little Brown & Co. Boston.
39. **Reader's Club Bulletin**, National Center for Children's Literature (NCCL), National Book Trust, New Delhi.
40. **Eye Teasers - Optical Illusion Puzzles**, Charles H. Paraquin, Granada.
41. **Simple Science Experiments**, Batstord, Hans Jurgen Press.
42. **Let's Discover Science**, David Horsburgh, Oxford University Press.
43. **The Scientific Kid**, Mary Stetten Carson, Harper & Row.
44. **Making Things**, Ann Wiseman, Little Brown & Co, Boston.

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21. **VSO Maths Teacher's Handbook**, Jane Portman, Jeremy Richardson (Hindi) Eklavya, Bhopal, 462016.
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29. **Energy & Self-Reliance**, Yona Friedman (Eng/Hin) Vigyan Prasar, New Delhi, [vigyan@hub.nic.in](mailto:vigyan@hub.nic.in)
30. **The Story of Physics**, T. Padmanabhan (Eng/Hin) Vigyan Prasar, New Delhi, [vigyan@hub.nic.in](mailto:vigyan@hub.nic.in)
31. **On the Various Forces of Nature**, Michael Faraday, Vigyan Prasar, New Delhi, [vigyan@hub.nic.in](mailto:vigyan@hub.nic.in)
32. **The Insect World of J. Henri Fabre**, Vigyan Prasar, New Delhi, [vigyan@hub.nic.in](mailto:vigyan@hub.nic.in)
33. **The Autobiography of Charles Darwin**, Vigyan Prasar, New Delhi, [vigyan@hub.nic.in](mailto:vigyan@hub.nic.in)
34. **Number Fun with a Calendar**, P. K. Srinivasan, Alarsri, Plot 5, Street 25, T. G. Nagar, Chennai - 600061.
35. **Mahagiri**, Pulak Biswas (Eng / Hin) Children's Book Trust, Bahadur Shah Zafar Marg, New Delhi 110002.
36. **Gayneck**, Dhan Gopal Mukerjee, National Book Trust, New Delhi 110016.
37. **From Bone to Stone**, Karen Haydock, National Book Trust, New Delhi 110016.
38. **The Joy of Making Indian Toys**, Sudarshan Khanna (Eng / Hin) National Book Trust, New Delhi 110016.
39. **Samajh Ke Liye Taiyari**, Keith Warren (Hindi) National Book Trust, New Delhi 110016.
40. **The Bicycle Story**, Vijay Gupta, Vigyan Prasar, New Delhi, [vigyan@hub.nic.in](mailto:vigyan@hub.nic.in)
41. **Aakash Darshan Atlas**, Gopal Ramchandra Paranjpe, NCERT, Sri Aurobindo Marg, New Delhi 110016.
42. **Manual for Mathematics Teaching Aids for Primary Schools**, P.K. Srinivasan, C.I.E.T. NCERT, New Delhi 110016.
43. **Resource Material for Mathematics Club**, P.K. Srinivasan, C.I.E.T. NCERT, New Delhi 110016.
44. **Letter to a Teacher, School of Barbiana** (Marathi - *Priya Bai*) Garware Bal Bhavan, Opposite Saras Baug, Pune -2.